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Single-Phase Motors. ALTHOUGH much has been written recently on single-phase alternating current motors, particularly in Europe, it seems to be generally taken for granted that this type has not yet assumed a practical form. We learn, however, that one firm in Europe has disposed of a considerable number of its design, and on the strength of the reliability and efficiency they have developed, orders amounting altogether to $100,000 have been received from a number of central stations for motors of this type. The motor referred to has no collector-commutator, and a large torque at starting is obtained. The frequencies for which they are designed at present are low, but it is claimed that, owing to the low frequencies used in Europe, no attempt has as yet been made to adapt them for high frequencies.

Electricity and Legislatures. THE growing importance of electricity is emphasized by the increasing part it plays in State legislatures. In Connecticut one of the events of the session was the fight over electric railways, the steam roads opposing legislation in their favor. While all that was asked for electric roads was not granted, yet they scored a substantial victory over their rivals in the bill passed. In Pennsylvania the fight of the session was over electric bills. One of these, relating to Philadelphia, required electric lighting contracts to be entered into for five years, and the other gave important privileges to a large traction syndicate. Owing to unpopular features and to the methods of the friends of the measures, both were defeated after a long battle. In Illinois a bill permitting municipalities to erect electric plants passed the Senate, and much recrimination is being indulged in on account of its treatment in the House.

Congress Proposals. IT IS gratifying to see that the Germans have taken such an interest in the good work started by the American Institute of Electrica Engineers regarding the proposed work to be done at the Congress. In accordance with the suggestion of the Institute the leading German society of electricians appointed a committee to discuss the American proposals, and their report is contained in full in the "Electrotechnische Zeitschrift," May 26, a full abstract of which will be found in our Digest. While in some respects they seem to have misunderstood the Institute's suggestions, their impartia criticism is on the whole very interesting, and it forms, together with the original suggestions and the discussion in France, the most important material for the consideration of the delegates. They express themselves as being decidedly in favor of a number of the suggestions, and make some few modifications in some of the others. While we do not agree with them entirely in the points in which they differ from the American proposals, their criticisms are of an intelligent nature and are well worth careful consideration. They seem to object very decidedly to defining expressions as well as to anything specifically English; in the former we differ very decidedly with them. They recommend making the C. G. S. magnetic units the "practical" units in preference to adopting a different system as originally suggested, a point which deserves the most careful attention.

Electric Traction. THE development of electric traction is now proceeding at a greater rate than ever before, and is still gaining in acceleration. "Networks" are being everywhere and almost daily projected, the greatest development in this respect being in northern Ohio, eastern Pennsylvania and northern New Jersey, where if all the schemes that have advanced as far as incorporation are carried out, the agricultural population in the network area will have almost urban transportation facilities. Of long distance lines, we print an important announcement in this issue in regard to the great Chicago and St. Louis line, which seems to assure the final success of this remarkable enterprise. In Pennsylvania and Ohio there are several lines of over a hundred miles in length that are expected soon to be started, and each week the projects appear to become bolder. As to street railways, it has been impossible for the large companies, even with their facilities increased to the utmost, to anywhere nearly equal the enormous demand for the necessary electrical apparatus, and their orders are now stated to be months behind and daily becoming more in arrears. As to the final extent to which electric traction will be adopted for long distances, it is interesting to note that in the history of steam roads the first lines were short, and that it was through the gradual connection of these that various lengthy systems were built up. As a consequence, the less ambitious lines of to-day may prove to be links in future great systems that will be gradually and therefore profitably developed, and which are indirectly being fostered by the development of the smaller interurban lines.

Long-Distance Transmission of Power. SOME months ago, in referring to the great field for long-distance electrical transmission of power offered in the United States, we pointed out that, while the attention of engineers and electrical manufacturers had thus far been entirely engrossed in the enormous development of electric lighting and traction, it was only a question of a short time when the important problems of long-distance transmission would be taken up. It has been characteristic of electrical development in America that but one branch of electrical engineering has been attacked at a time, all attention being concentrated on one object alone until thoroughly achieved. This fact and the practice of narrowing applications by adhering to various "systems" (a practice happily becoming rapidly extinct) prevented the consideration of long-distance transmission of power in the United States, except in a few isolated instances, when it had become a large factor on the Continent. Recently, however, this branch has been taken up in earnest, and we may expect the same wide and even rapid development that has been witnessed in arc and incandescent lighting and in electric traction. Thus far the most important work in this line has been done in the West, and particularly on the Pacific slope, where several important plants are already in operation and several others in process of installation, reference to some of which is made in the important paper of Mr. W. F. C. Hasson, the first half of which we print in this issue. In addition to these we learn that one company has five long-distance projects in hand. An important point to be noted is that all the work thus far seems to have been thoroughly considered from both a commercial and an engineering standpoint rather than from a speculative one based on makeshift methods, as has too often been the case in other electrical branches. In two cases the power to be transmitted is considerable, 3,000 and 3,500 h. p. respectively, but over short distances, and the longest distance is very moderate. Owing to the nature of the case, each problem will have to be considered on its own merits and by competent engineers, so that the development will be very thorough and at the same time satisfactory, and the extension to longer distances and higher voltages is, therefore, more apt to be based on correct principles and practice. It is very doubtful, however, taking all the elements into consideration, if it will as a rule be profitable to transmit electrical power to the great distances that have sometimes been proposed, for several hundred miles, for instance. The advantage in the cost of water power over steam power under ordinary circumstances is not as great as is popularly supposed, but, on the other hand the cases of water power that may be cheaply developed, and of localities where steam power is expensive are so numerous that the field for development is sufficiently large for the present even if thus narrowed.

The Economy of Small Central Stations. IN our issue of April 15 we referred editorially to the poor showing made by small central stations in the annual report of the Massachusetts Board of Gas and Electric Light Commissioners, and suggested a number of reasons to account for the failure to make both ends meet. In this issue we print the first part of a paper by Lieutenant Cahoon, bearing on the same subject, which has an unusual value not only from the experience and knowledge of the writer on the subject, but also from the manner in which it is treated. The station in New York which Lieutenant Cahoon cites as an instance of false economy is unfortunately representative of perhaps the majority of smaller stations. Owing to the profound ignorance of the public in regard to the details of electrical matters and the mystery which they consider surrounds everything electrical, they are apt to entirely disregard the principles that they apply in the ordinary transactions of life, and this seems to be particularly true when, without the aid of competent advice, they decide to install a lighting plant. The selling agent in this case is also a large factor, as he enhances the chances of making a sale by advising a cheap construction and by representing that a local engineer or cheap electrician will be entirely competent to run the plant when completed. When the electric light is introduced in a smaller community it is naturally regarded somewhat askance and as the price is often in advance of that of gas and always very much above that of kerosene, any unreliability developed at once gives it a "black eye." In a recent case a plant was installed in a small town with excellent prospects of pecuniary success, but with prospective customers amounting to a majority holding off to see how satisfactory the light would prove. Unfortunately, however, it was decided to install the plant in an addition to a sawmill in order to use the mill boilers (20 years old), a second-hand engine was purchased and a man employed as an electrician whose entire electrical experience was gained in working on the line when being erected. During the first month the plant was shut down several times, the regulation of the light was poor and as a consequence the electric light was considered unreliable, or a failure, and the plant has been taken out. Where any unreliability of working is apparent to an entire community, as is the case of an electric lighting installation, no risks should be taken. A competent engineer should be selected to lay out and supervise the erection of the plant, and reliability rather than price should be the criterion applied to the machinery and material. If small non-paying stations were to profit by the methods of the syndicate referred to by Lieutenant Cahoon, they would eventually place themselves on a paying basis. This is the true remedy, unlike the one recently proposed by a contemporary—an advance of 50 per cent in rates—which is suggestive of the remark of the French princess who, when told that the people were dying from want of bread, asked in astonishment why they did'nt eat cake.

World's Fair at Short and Long Range.

It is interesting to note the different effects produced upon different classes of observers by the great Tower of Light in the centre of the Electricity Building at the World's Fair, and perhaps no more attractive place to study these effects can be found than in the columns of our electrical contemporaries.

The Electrical World feels in a position to review these emanations more dispassionately from the fact that it practically covered this ground more than two months ago in a full-page illustration of the subject under review. We therefore take somewhat the same interest in the attempts of our enterprising contemporaries to grasp the magnitude of the undertaking that a parent does in the first essays of his young hopeful to walk erect and alone. It matters not to the parent that his child is more backward than its months would imply; its efforts to keep right side up are none the less applauded nor its successes less appreciated.

First of all, there is our Western contemporary—always enterprising, always alert and bright; it plumes itself upon a genuine scoop, for such it succeeded in making, upon its more conservative contemporaries who believe in the old adage that "All things good come to him who waits."

This journal came out a whole week in advance of the others, and therefore may justly pride itself upon being a good second to (and only two months behind) The Electrical World.

We pause, however, to inquire: Did our bright Western contemporary get its picture and information from "improper, irresponsible parties," or were they obtained with the "sanction and approval of some one in authority?"

This is a serious question which must be settled between the editors of our Western contemporary and their consciences.

Editors, The Electrical World has always maintained, possess consciences.

Another contemporary that usually discourses in the first person singular and writes as some of the special war correspondents are reputed to have done—a thousand miles from the scene of action—and that defends its course through a proxy located a thousand miles from where the mistake was made, essays a week later to outdo the wooly West by presenting, in addition to a cut of the tower, a full-page reproduction of the carpenters' plans.

Although it states that its view of the prismatic bulb (given in The Electrical World some two weeks before) is a vignette, and has apparently been misinformed with regard to the colors on the tower, "ventures to hope and believe" that they are "presumably accurate."

This last contemporary leaves no doubt in the minds o. its readers that it obtained its material with the "sanction and approval" of the proper authorities, for it says so. It, however, possibly from past experience in this direction, still feels a little dubious of its ground, as evinced by the pathetic qualification which we quote.

We judge that the article above referred to is a composite, for while the carpenter work is creditably illustrated, as was that of the fountains, and the drawings probably made on the spot from tracings, also furnished by authority, another portion must have been evolved through the long-distance telephone, or written as seen through the haze of leagues and leagues of intervening space.

We are led to this conclusion from the fact that the lamps on the tower are stated to be red, white and blue, whereas there is not a blue lamp on the structure.

The illumination of the prismatic bulb, however, which is described as "superb" and in regard to which the statement is made that "It is a pity the Statue of Liberty could not hold aloft such a crowning glory of flashing lights," could only have been so described at close quarters, for it could not have been seen through the haze of even a single mile.

If, therefore, this article is not a composite, the question is, was it written at short or at long range?

However this may be, The Electrical World is interested in these efforts of its youthful, though none the less esteemed, contemporaries to outdo each other, and wishes to do what it can to encourage them.

The Chicago-St. Louis Electric Railway.

Dr. Wellington Adams, who has just returned from New York to Chicago, is personally responsible for the following statements in regard to the great project with which his name is identified:

The Chicago-St. Louis Electric Railway Company have closed a contract with the General Electric Company for the entire electrical equipment of their road according to their plans and specifications, which form part of the contract. These specifications call for motors capable of operating the trains at a speed of 100 miles per hour at an efficiency of 90 per cent. There will be not over four nor less than three power stations, depending upon the desirable locations available, and steam will be used exclusively, the water-power project having been entirely abandoned. The current will be distributed at 20,000 volts and transformed down to 2,000 volts for use. The road will be divided up into ten-mile sections, into which the current will be fed at the lower potential.

The total average efficiency of the system from the engine pulley to the car axle will be at least 60 per cent, and 65 per cent is expected.

But a single trolley wire will be used, with a ground return, and polyphased motors will be employed on the cars. Twenty miles of roadbed are already completed and the work is steadily progressing. The present stringency in the money market, of course, has annoyed them somewhat, but has not seriously inconvenienced them further than to make their progress somewhat slower than it otherwise would be. His suit against the Lindell Railway Company of St. Louis, in which the General Electric Company is the real defendant, is in active preparation and is expected to come up for final trial in February next.

The Economy of Small Lighting Stations.—I.

BY JAMES B. CAHOON.

Quite recently my attention has been called to the purchase of small stations that have been failures from a financial point of view, if not from an electrical, and inasmuch as these purchases have extended over a wide territory, covering several stations in different parts of the country, it would seem to indicate that there has been something radically wrong in their management from the beginning. Upon making a careful investigation it would probably be found that each of these plants was purchased for about one-sixth to one-fourth the amount originally expended in its installation, and further, that the plants themselves have been running down for some time past, or, in other words, that as soon as the machinery was unable to take care of itself the quality of the light furnished and the service in general began to deteriorate.

Were we to plot the service as a curve starting from the origin, which might be called the signing of the contract, it would be found that in almost every instance the first part of a sine curve would be plotted, the service ascending rapidly to a maximum as the plant got into good running condition, then gradually turning and commencing to fall off as the plant got a little older and the service poorer, until it got so bad that orders ceased to come in, lights were ordered taken out of stores and private dwellings, the town refused to pay for the service, and general collapse ensued, thus bringing the curve of service back to the axis from which it started.

Quite large amounts of money have been expended, the electrical profession has received a black eye, electric light service two black eyes, and all because the plant was founded on a false system of economy. It certainly seems strange to a thinking man of the present day that men who are rated as sound business men in their own profession and business should get together form a stock company for the purpose of building a plant to light the town, and then fail to consult a competent engineer in regard to the installation of their plant, making of their plans, and supervising the work in general. This is the first false move, and the second is quite as bad, which is the employment of some young man who has a slight knowledge of electricity in general, knows something of engines, and has seen a boiler fired, to take the position of superintendent and electrician because his services can be obtained for about $60 a month. Following out this system in the employment of the men under him, the selection is made usually on the score of economy—that they must get as cheap a man as possible—and accordingly they get some man for a fireman, and pay him $1.50 a day, a lamp trimmer for the same price, and so on; the result being the failure of the station as above mentioned, and its purchase by a syndicate who understand the business, have the advice of a competent engineer, select first class workmen for their station, pay them good wages, purchase new apparatus of the best make, reconstruct their lines and overhaul the plant in general, putting it in first class condition, and in the course of a year or two we find them paying a very handsome dividend on the amount expended, and quite sufficient to pay a six to eight per cent. dividend on the total amount that has been expended on the plant.

This naturally leads up to the question of what is economy as applied to our small central stations. If I were to go to a tailor for a suit of clothes, I would find that the tailor would be willing to give me a suit from one piece of cloth at, we will say, $25, while from another this of about 6¼ per cent., and then quite extensive repiece of cloth, which apparently does not look much better, he will give me a suit for $40. Then arises the question: Which is it economy for me to purchase—the cheaper one, which I know contains shoddy, or the more expensive one, which he will guarantee to be of first class material and the best make?

Having lived a few years and acquired a little experience from the purchase of both kinds, I immediately decide that the $40 suit is the one I want from the economical standpoint, for I can use it two, if not three, seasons, and it will always look well, while the other suit would look like a ready-made suit inside of three months; it would be utterly impossible to wear it another season. I pay a little more in the beginning, but I save almost the price of another suit in the end by so doing.

This will illustrate the word economy as applied to our small central stations, and it is quite unnecessary to refer to the large stations because they are run on business principles from the start; they cannot afford to do otherwise, though, of course, some are run much more economically than others, yet the economy of one as compared with another does not vary much over one per cent. to the stockholder.

Let us take two small country stations and see wherein they differ. Take one in the State of New York, the other in the State of Vermont; the first one being run on false economy, the latter one of the rejuvenated stations. These two stations are not many miles apart, and the services of an expert has been necessary at each within the past year. We will describe each in detail as far as possible, taking the New York one first. There were two lots offered for the station, one of which was near the centre of the town and alongside the railroad track just at the end of one of the sidings. The price of this was about three times what they could get the other lot for, which was situated on the outskirts of the town, back about half a mile from the railroad track; but as they got the lot cheaper they decided to take it. As they had saved quite a little in this way, it was determined to put up a fairly good building, and therefore a brick building was erected under the supervision of the vice-president of the company, who had had some experience in building. As the station was in an out-of-the-way place, only the cheaper grades of brick were employed in its construction, and a dry stone foundation used, which was pointed up on the inside. Although they would have to use some 400 or 500 h. p. in order to furnish the town and their customers with light, it was thought best to purchase only one engine, and therefore provision was only made for this, and a foundation some 5 feet in depth was made of rubble, with a top of three courses of brick. It was not deemed necessary to provide foundations for the dynamos, as none of them would be of any great size, but an extra thickness of 2-inch plank was put down where the dynamos and jack shaft were to be situated. The boiler house was not separate from the station, but occupied one end. Cement foundations were provided for the boilers, and in front the earth was leveled off, forming an ordinary dirt floor. In order to get the light at the end windows, the boilers faced toward the outer wall. The engine was placed at the other side of the partition, back of the boiler. The ordinary high-pressure is used, exhausting into the atmosphere. No provision is made for heating the feed water, which is pumped in cold. The steam pipe leading from the steam drum makes four rightangled turns by the time it gets to the engine, the latter being of a well known make, and capable of doing good service. The boilers were also good of their kind, and the electrical apparatus was first-class and was well installed at the station. The company decided, however, to let out the contract for putting up its overhead lines to a local contractor, who made a fairly good job of it, doing his work as well as he knew how, but was compelled to use cheap wire and cheap poles in his construction on account of the kind of wire and poles being specified in his contract. After all was finished, the son of one of the directors was put in as superintendent and business manager, with an electrician and chief engineer at a salary of $75 per month. His lamp trimmers, of which he had three for something under 200 lamps, did not receive very much pay because they did not have very much to do, as they only had between 55 and 60 lights apiece to trim.

As near as could be figured, subsequently, the boilers used about five pounds of ordinary soft coal per horse power. There was no means of determining what the evaporation of the boilers was, i. e., how many pounds of water per pound of combustible. The first year quite extensive repairs had to be made on one of the boilers, owing to the crown sheet having burned through, due to the carelessness of one of the firemen in letting the water get too low; and the armature of an arc machine, which was designed for 50 lights, had to be twice replaced on account of overload, the superintendent boasting he could get 80 lights out of it, and usually did did so, having at one time, he said, run as high as 85 lights. At the end of the first year the plant showed an apparent dividend of a little over 5 per cent. on the investment, the next half year showed an increase on pairs had to be made on the engine, the line kept giving trouble from frequent grounds, the insulation dropped off the wire, and so on. From that time on the plant has never shown a dividend of over 2¾ per cent.

(To be continued.)

Paris Underground Wires.

La Compagnie Popp, Paris, France, is going to adopt a new underground conduit system. Heretofore its conductors have been carried in cast iron tubes in paraffined wood ducts; these are to be displaced by lead covered and armored cables placed directly in the earth, as in the case of several recent underground installations in Paris. There will be subterranean galleries only at the crossings of the streets.

Technical Education in Europe.—II.

BY FRANK C. PERKINS.

GROSSHERZOGLICH HESSISCHEN TECHNISCHEN HOCHSCHULE ZU DARMSTADT.

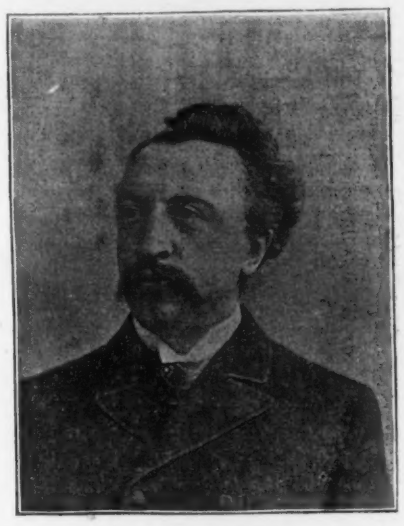
The city of Darmstadt has about 50,000 inhabitants, and is situated a short distance south of Frankfort-on-Main. The Polytechnicum, or technical school, is located in the eastern part of the city, near Huegel Strasse, and opposite the City Chapel (Stadtcapelle), as will be seen from the accompanying illustration (Fig. 1) of the main building.

This institution is exceedingly well equipped for studies in electrical engineering, and although the apparatus is in many ways similar to that of other schools in Germany, yet there are some essential differences which are of interest. The total number of students in this college, at the time of the writer's visit, was 406, of which number 160 were taking the course in electrical engineering.

The Electro-Technical Institute (Fig. 2) is under the direction of Prof. E. Kittler, Geheimer Hofrath, who was one of the members of the Pruefungskommission at the Frankfort Electrical Exposition. He is asisted in electrical work by Dr. Karl Wirtz and Prof. Robert Friese. The full course requires four years for completion, and some of the studies taken up in the different years are as follows: The first year the electro-technical students take algebra and geometry under Prof. Mehnke; higher mathematics under Prof. Grundelfinger, and mechanics under Prof. Henneberg. They are also expected to attend the lectures and take laboratory work in experimental physics and inorganic chemistry. These lectures are given by Profs. Staedel and Kumpa. Mechanical and freehand drawing is also required throughout the first year. The second year is devoted to higher mathematics, mechanics and lectures on the elements of electro-technics by Prof. Kittler; also lectures by Prof. Marx on the elements of machine construction.

The physical and mechanical laboratories are in charge of Profs. Schering and Lincke. During the third year a greater portion of the work is in the electro-technical laboratory, and the lecturers take up the following subjects; Mathematical electricity, dynamo-electric machinery, electrical transmission of power, and electrical measurements. The last (fourth) year is a continuation of the work of the third year in the electrical and mechanical laboratory. Tests are made in power transmission, together with experimental work on air and gas engines and electrical generators.

Very few of the German technical schools give practical tests with steam engines in the electrical laboratories, in connection with dynamos and motors, and this is certainly one of the great disadvantages students meet with in these schools. In nearly all of the dynamo rooms the power is furnished by gas engines, and the steam engine is conspicuous for its absence. In this institution there are two dynamo and engine rooms, which are very well equipped. The power is furnished by two gas engines, one in each engine room, developing 6 h. p. each at a speed of 250 revolutions per minute. They are Otto engines, and were manufactured by the Gasmotoren Fabrik von Deutz. The new dynamo room is on the ground floor of a new building (Fig. 2), used only by the electro-technical department. In this building there are several direct and alternating current machines, furnished by the principal electrical firms of Germany. Some of the larger machines in the building are: One shunt machine by Schuckert & Company, of Nurnberg, generating 380 amperes at a potential of 8 volts, with a speed of 1,000 revolutions per minute, and is used for galvanoplastic work; one alternating machine by Siemens & Halske, of Berlin, generating 15 amperes with 300 volts, at a speed of 700 revolutions per minute; also a drehstrom-gleichstrom (continuous-current-multiphase) generator built by Schuckert & Company, having a capacity of 10 amperes and 80 volts, at 1,200 revolutions per minute. The latter machine can be used as a transformer, being driven by a continuous current (gleichstrom), and generating for use in the laboratory a multiphase current (drehstrom). Schuckert & Company have also furnished this institute with a drehstrom motor of 2 h. p. Among the other machines are several shunt and compound dynamos from Gebruder Naglo, of Berlin, and a large Weston dynamo built by Moehring & Company, of Frankfort-on-Main. The latter machine generates a current of 60 amperes at



PROF. E. KITTLER.

150 volts potential, with a speed of 1,200 revolutions per minute. The laboratory is equipped with a large assortment of ammeters, voltmeters, and other measuring instruments, as well as 24 arc lamps from the following companies: Siemens & Halske, Schuckert & Company, Oerlikon Company, Gebruder Naglo, and the Allegemeine Electricitaets Gesellschaft. The stock of incandescent lamps includes a large number of various sizes and kinds. The photometer room is located in the large annex building, and is arranged for testing both arc and incandescent lamps. The photometers used are of the types of Bunsen, Weber, Rousseau, and others. The transformers were supplied by Ganz & Company, of Budapest; Gaulard & Gibbs, and Schuckert & Company.

A very fine accumulator plant is also found in the annex building, and although not of enormous size, it represents several of the different types of German storage batteries. One set of accumulators comprises 60 cells of the Tudor type, furnished by the Koelner Accumulatorenwerke of Hagen. These cells have a capacity of 38 ampere hours, and are discharged at 6 amperes. They are charged with four sets in parallel at 24 amperes and 40 volts. Another set comprises five cells of the Khotinsky type, using a charging current of 20 amperes and a discharging current of 24 amperes. A set of six cells was furnished by Gotfried Hagen in Kalk bei Koeln. These cells are quite large and may be discharged at 45 amperes and charged at 40 amperes. Other types of accumulators of the Young system and the Fabarsky-Schenek system, from Goetz & Odendall, of Austria, are in use, the latter having a discharging current of over 400 amperes. At the time of the writer's visit a plant was in process of construction for work in high potentials. The potential was to be 560 volts and the battery to consist of 280 cells. Another battery was also being installed which would have the enormous discharging current of 600 amperes. It consists of two cells, each having 72 plates, of which 37 were positive and 35 negative. A large direct current Siemens & Halske dynamo of 1,000 volts was also being set up.

GROSSHERZOGLICH BADISCHEN TECHNISCHEN HOCHSCHULE ZU KARLSRUHE.

The Physical and Electro-Technical Institute at Karlsruhe is under the direction of Dr. Otto Lehmann. The total number of students registered is 640, of which 260 are taking a special course in physics, and 60 are taking the regular course in electrical engineering. The plan of study in the course of electrical engineering is similar to that at Darmstadt. During the first two years the same studies and experiments are taken up as in the course of mechanical engineering, the principal difference being that the latter part of the second year in electrical engineering is partly devoted to the study of telephony, telegraphy, static electricity and electroplating. In the third year the subjects include "Theoretical Electricity," under Prof. Lehmann; "Dynamo-Electric Machinery" and "Machine Construction," under Prof. Hart; "Electric Lighting Apparatus," "Transmission of Power by Electricity" and "Steam Engines," by Profs. Kellar and Meidinger. During the fourth year a greater portion of the time is spent in the physical and chemical laboratories, and tests of dynamos and motors are made.

The students at Karlsruhe take an excursion of two or three weeks each summer, visiting the principal electrical manufacturing establishments in Germany, from which they receive great benefit. For a number of years past similar excursions have been made in the States, during the spring vacations, by students in electrical engineering at Cornell University, and a great deal of practical knowledge is obtained during these trips which could not be obtained in any other way.

It is particularly noticeable in all of the technical schools of Germany that the electrical equipments are decidedly German. Scarcely an instrument, dynamo or motor of foreign make, whether French, English or American, can be found in any of the laboratories, with the exception, possibly, of Weston ammeters and voltmeters.

It would be practically only a repetition to describe the apparatus belonging to these laboratories and dynamo rooms, as the motors, arc lamps and measuring instruments are nearly the same as those described in the first part of this article. The motive power is obtained from an 8 h. p., double cylinder Otto gas engine, from Deutz. The lecture room of this institution is especially well adapted to the study of different systems of electric lighting. The ceiling of the lecture room is wired for arc and incandescent lights, according to the two-wire, three-wire and five-wire systems, and in different circuits which may be manipulated by switches from the desk of the lecturer. Arc lamps are shown running in series and parallel, both separately and with incandescent lights on the same circuit. In the physical laboratory of this institution is an influence machine, which is of especial interest and will bear a description. It is called the Horhdruck influence machine, and was built by O. Leaner, of Dresden. The machine consists of 180 glass plates, of which 120 are stationary and 60 revolving. The diameter of each plate is 8-10 of a metre, and the length of the iron cylinder containing the plates is 1½ metres. The cylinder, inclosing the plates, is constructed to withstand an air pressure of 10 atmospheres. The usual pressure, when the machine is in operation, is four atmospheres, as indicated by the gauge. The sparks obtained from this machine are 20 centimetres long. Some very interesting experiments have been performed with it. It is operated by an electric motor built by Garbe, Lahmeyer & Co., of Aachen. The speed of the motor is 1,500 revolutions per minute, with a current of 20 amperes and a potential of 80 volts.

The accumulator plant of this school is considerably larger than those heretofore described. It consists of 72 cells of the Tudor type, connected in two sets of 36 cells in series. The capacity of these cells is 70 ampere hours, with a charging current of 18 amperes and a discharging current of 21 amperes. A large number of cells of various other makes are also connected with this accumulator plant. It is clearly seen that much more importance is placed on the storage battery in these institutions than in the technical schools of the United States.

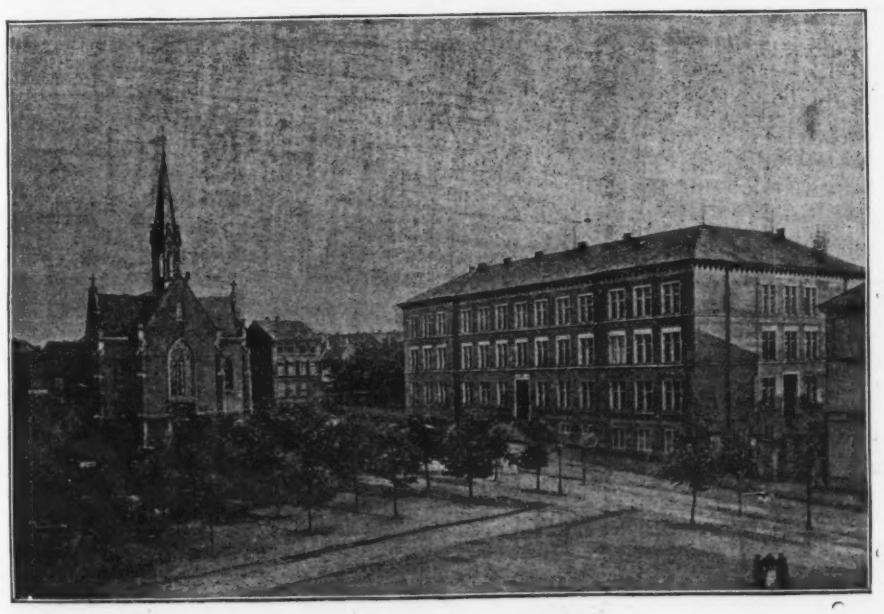


FIG. 1.—THE POLYTECHNICUM.

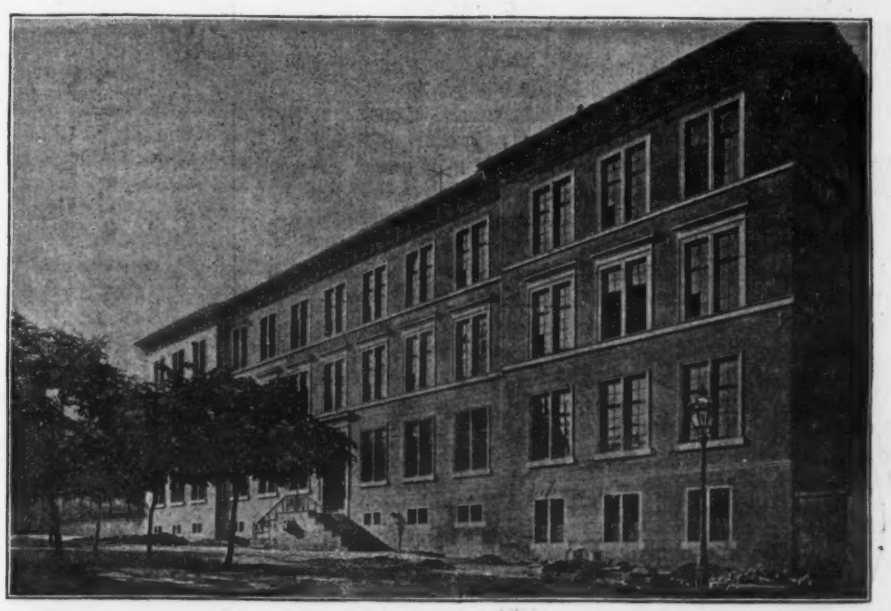


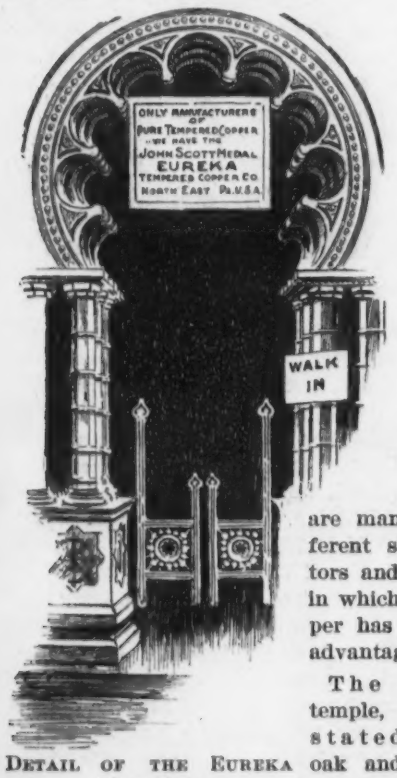
FIG. 2.—ELECTRO-TECHNICAL INSTITUTE.

Electricity at the World's Fair.

EXHIBIT OF THE EUREKA TEMPERED COPPER COMPANY.

COPPER, in a large variety of forms, presents a very attractive display in a Moorish mosque in the southwest gallery of the Electricity Building overlooking the main nave of the building. This mosque covers a space 17 9-10 feet by 14 feet, and is entered from the east through Moorish arches appropriately colored and decorated. Within the fittings are of oak, which are paneled and draped in black velvet showing to highest advantage the brilliant copper shapes for which this company has become so well known. As is well known to the trade, the material manufactured by the Eureka Tempered Copper Company is pure copper, which by means of a secret process they are enabled to cast without blowholes, and by a second secret process to harden to meet the various demands of the electric fraternity as well as of the mechanical engineer. It is claimed and analyses have proved that their castings are free from flaws, and it has been accomplished without resort to the use of alloys, which invariably detract from the electric conductivity of the copper and otherwise change its physical characteristics.

By their tempering process not only may the copper be materially hardened, but also its tensile strength enormously increased. Its ability to resist crushing strains is also enormously added to. For instance, the tensile strength of the tempered copper is increased to 64,000 pounds per square inch, whereas ordinary copper reaches but about 34,000, and it will resist a crushing strain of 180,000 pounds to the square inch. Another advantage added to the copper by the process controlled by this company is that it may be readily forged by hand, making an excellent joint, and can otherwise be handled by the blacksmith very much as can iron and steel. The hardening process enables it to withstand for much longer time the abrasive effect of friction, and this, together with its anti-friction qualities, its resistance to crushing strain, and its hardness, renders it an excellent material for journal bearings, of which many samples are shown. For such purposes it has the advantage of brass in its greater hardness and its ability to stand up much longer. It is also said to have superior anti-friction properties, and since its fibre is preserved throughout the mass it is much tougher. While the tensile strength of copper is about doubled by the tempering process, the electrical conductivity is little, if any, reduced, and thus it is enabled to supplant the bronzes for such purposes as trolley wires, etc., where both tensile strength and conductivity are essential qualities.


ONLY MANUFACTURERS OF PURE TEMPERED COPPER WHO HAVE THE JOHN SCOTT MEDAL
EUREKA
TEMPERED COPPER CO.
NORTH EAST PA. U.S.A.
WALK IN

Detail of the Eureka Mosque.

The purity of this copper has been shown by analysis to be in the neighborhood of 99.981 per cent., and its conductivity much higher than phosphor or silicon bronze, while it has double the tensile strength of hard drawn copper.

Standing on the floor, and on a shelf raised about 1½ feet above it, are many samples of different styles of commutators and other large work in which the tempered copper has been employed to advantage.

The walls of the temple, which, as before stated, are paneled in oak and draped in black velvet, are decorated with the smaller pieces of the metal in shapes manufactured by this company. Beginning at the south the panels are lettered from A up to G at the north.

Panel A is devoted to specimens of roll copper suitable for commutator brushes, etc. Here also are displayed samples of the first work on bearings made by the company. Some of these show samples of bearings used on a well driving apparatus in Pennsylvania. Another is a bearing used on engine 2,020 from March 21, 1887, to October 30, 1888. This engine was employed on the Pennsylvania road, and during that time covered 96,347 miles. So little wear is apparent on these bearings that the sandmarks of the molds are still perceptible. Another bearing was one used by S. J. Gifford on a sawmill, and another is a bearing used on a crosshead for three years on an engine 12×18 making 200 revolutions. Still another was used on a crank-pin for 18 months. All of these are in excellent condition, notwithstanding the extended use to which they have been put.

In panel B is displayed a large cylinder for acids. This is a beautiful piece of copper work 2 feet high and 5 inches in diameter, and highly finished on the outside. Several saws are also displayed. It is not claimed, we believe, that the tempered copper is suitable for saws, but these are shown merely as an exhibit of what can be done in this line. Street railway pinions, hammers and hatchets and a large commutator spider are displayed here. Toe weights for horses and bells are exhibited, and veterinary firing irons and knuckle joints add to the variety of the display.

In panel C are shown still more commutator segments, one of which weighs upward of 96 pounds. This was made for the Westinghouse company, and said to be the largest commutator segment ever made.

Standing on the floor in front of panel D is a very handsome fireplace set, consisting of the stand, shovel and tongs, made of the tempered copper and of the highest finish. On the panel itself is quite a collection of commutator segments representing the types used by all of the principal manufacturers of this country.

At the base of panel E are shown completed commutators of various types, commutator heads for electric railway motors and copper rings or cylinders for Brush commutators and commutators for Western machines, also washers for commutators.

Panel F contains a lot of street railway armature bearings and a large lot of soldering coppers, and a beautiful specimen of copper casting, a rod 2 feet long and 1½ inches thick turned and beautifully polished. Trolley wheels and centres are also generously shown, and there hangs in a prominent position a policeman's billy made of tempered copper and highly polished. This has a cord and tassel made of the same material, and is a very attractive piece of work. Its toughness would probably insure its lasting qualities where implements of this kind are required. This will be given at the end of the Exposition to the Chief of Police of Chicago as a souvenir of the World's Fair.

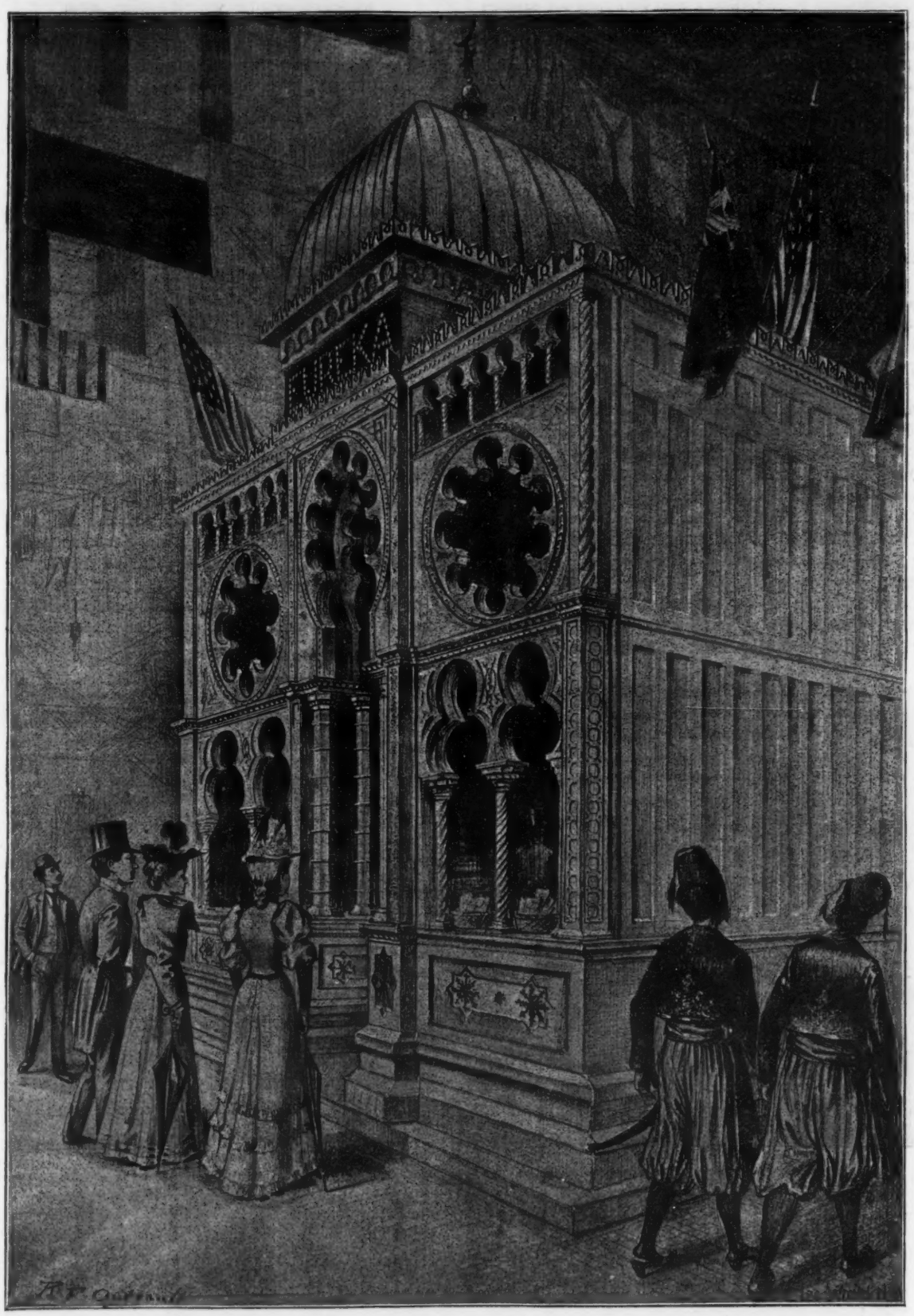


EXHIBIT OF THE EUREKA TEMPERED COPPER COMPANY.

In panel G are more commutators, magnet wires and a buggy thimble. It is claimed that thimbles made of the tempered copper will run with less oiling and less heating than steel and that their lasting qualities are greater. The sign "Bare and Insulated Copper for Electric Work" wrought in short lengths of both bare and insulated copper wires occupies most of the space in this panel. The

A Bad Tempered Copper.

effect is fine and the idea good. The last panel is filled with ornamental figures made of thin rolled copper, some as thin as No. 48 B. & S. gauge. These are to illustrate the character of their thin rolled copper, and this is worked into rosettes, etc. Some copper horseshoes are also shown which were forged by hand and the whole exhibit makes a very attractive and unique display.

KERITE
STATION MANAGER:—Confidential, we are having so much trouble with our Circuits that the plant don't pay. Our customers are dissatisfied, and I am pretty nearly discouraged.
VISITING MANAGER:—Why don't you tear out your old circuits and put in a good reliable wire same as we did. We never have any trouble now, and our plant pays handsomely.
STATION MANAGER:—What wire are you using?
VISITING MANAGER:—Give me a light and I will tell you!
DIRECTIONS:—Touch the lighted end of a cigar or cigarette, or any spark, (not a flame) to the man's cigar in the picture and watch the result. Do not use a match.
A. J. Gesswein, Spelling Sparks, Chicago.

WHAT THE SMOKE SAYS.

This company, it will be remembered, received the John Scott gold medal from the Franklin Institute for 1891, which was awarded them for the invention of highest merit.

DAY'S KERITE.

The display of these well known wires occupies a space of 1,060 square feet in the southeast corner of the Electricity Building in the gallery. In the centre of this has been erected a handsome pavilion 10×12 feet, which in the interior is furnished in sycamore and illuminated by a number of incandescent lamps. A lounge, several chairs and a table are found here to make the stay of the visitor comfortable, and two ventilators in the roof assure an abundance of fresh air.

Outside, the building is finished in white and gold and across the roof at some distance above and at an angle with the lines of the building hangs a handsome sign painted white and lettered in gold. On the east side are found the portraits of A. G. Day and A. G. De Wolf, who have long been connected with the Kerite interests. In the centre is another large picture representing the tug Western Union laying an 18-conductor telephone submarine cable from New York to Jersey City. Beneath these pictures are short lengths of cables of various kinds. On the north side are three diplomas which have been received by the company for its wires, two of which were from the Centennial and one from the Paris Exposition. These were awarded with the medals of which we shall speak latter on. Just north of the pavilion is a column which has been draped in the national colors and with the Italian, French and United States flags.

The west side has in its centre a large photograph representing the laying of an 18-conductor cable taken after the cable had been landed on the Jersey shore. On the other side of this are samples of wires insulated in the various ways of this company. In front of the building is a table with wires of various colors for interior work. Rising from the floor is a pyramid consisting of eight reels of wire, the whole surmounted by a triangle, composed of three short lengths of 154 conductor cable. There is also a column in front of the building draped with the national colors and the German, Spanish and United States flags.

Extending vertically along the sides of the base of the pillar are various samples of armored cables. Over the front door, which is on the south side, is the name W. R. Brixey, to whose energy is due much of the reputation which this firm now enjoys. On either side of the door are pictures of the steam tug Western Union engaged in laying a submarine cable. The outer edge of the platform upon which these displays are made is occupied with showcases and tables containing various samples of the products of the works. At the four corners of the building are shown what may be called the crude material from which the Kerite insulation is made, namely, the living india rubber plant. On the table in the southwest corner are shown samples of the crude Para rubber as received; also samples of the Kerite compound, which having been strained through a colander looks very much like a mass of black vermicelli, if there is such a thing. This straining is done to remove pieces of foreign matter which are apt to find their way into the crude material. This Kerite compound is a mixture of pure Para rubber and the crude Kerite. To the right is a show case showing Kerite tape and many samples of cables for electric lighting and telegraph and kindred purposes, tape for waterproof joints and also the Kerite elastic tape for the same purpose. To the right of this show case on a table is a pyramid of crude Kerite in blocks of 2½ inches thick, there being eleven blocks in the pryamid, while further to the right we find a series of spools increasing in size from 2 to 4 feet. Number 1 is a reel of feeder wire for electric light purposes. No. 2 is a 10-conductor cable, No. 3 a 19-conductor cable for telegraph purposes, No. 4 a 2-conductor armored submarine cable, No. 5 a 60-conductor underground cable, and No. 6 a 7-conductor armored submarine cable. These are all for telegraph purposes. Just north of the building are arranged another series of reels, No. 1 being an 8-conductor underground telegraph cable, No. 2 a 3-conductor armored submarine telegraph cable, No. 3 a 50-conductor armored submarine telegraph, No. 4 a 5-conductor armored submarine telegraph, No. 5 a 91-conductor real telegraph cable, No. 6 a 6-conductor armored submarine telegraph cable, No. 7 a 37-conductor underground telegraph, No. 8 a 4-conductor armored telegraph cable, No. 9 a 100-conductor underground telegraph, No. 10 a single-conductor armored submarine telegraph cable, and No. 11 a 61-conductor underground telegraph cable.

On the east side in the case to the north are samples of submarine cables of various sizes. There are also samples of feeder wires stranded and uses, also samples of all kinds of telegraph and telephone cables and tape.

In this case are exhibited the two medals that were awarded; the one at the Centennial in 1876 and the other at Paris in 1878, of which the company are justly proud. These were both the highest awards for insulated wires, and a company which like this one can trace its history back as far as 1876 may justly claim to be pioneers in the insulated wire business; but Kerite is older than this, as it has been in use for more than a quarter of a century, but never to the same extent as now.

In the southeast of the space allotted to this company is a reel of 154-conductor underground telegraph cable, and on top of this a smaller one on which is wound an 8-conductor cable, the same as furnished the New York Central & Hudson River Railroad for the equipment of their block system, for which over 300 miles were used between Albany and Buffalo.

Just north of the building are arranged four pyramids of reels of wires of various colors and sizes, each composed of eight reels.

This completes perhaps the largest display of insulated wire in the Electricity Building. Considerable taste has been displayed in the arrangement of the exhibit, and it is one of the first to have been completed in the Electricity Building, which certainly must stand to the credit of Mr. Brixey, who has been untiring in making his display so complete.

The display itself is in charge of Mr. Eckert, who is glad to give every information that inquirers may seek.

Mr. Brixey has hit upon a novel and unique advertisement which is being distributed at his display, which consists of a small sheet upon which are pictured two gentlemen who are discussing wires. One has had trouble with that he has been using, but the other has been more fortunate with another brand. The latter volunteers to tell what has been so successful in his station, but asks for a light for his cigar first. If the tip of his cigar is touched by a spark, that spark eats its way to the top of the paper, and there spells out the word Kerite.

EXHIBIT OF W. R BRIXEY.

EXHIBIT OF THE NATIONAL CARBON COMPANY.

This, the largest manufacturing establishment of carbons in the United States and the second oldest, presents a unique display of its goods in the eastern gallery. Its space is surrounded by a neat bronze railing, and within has been erected a pavilion seemingly composed of specimens of its goods. The bases of the pillars are made of corrugated carbon plates alternating with copper plated electric light carbons to form the lower halves of the cylinder, and the upper halves are composed of large carbon rods 1½ inches in diameter. The capitals are composed of carbon discs separated by copper plated carbon brushes, and the four pillars thus composed support a square canopy which is draped within with red, white and blue bunting. In the centre beneath this canopy has been erected a pyramidal shaped structure entirely composed of battery carbons. On the west face of this, retreating shelves support rows of electric light carbons, carbon brushes and carbon shapes of various kinds which have been arranged in tasteful designs which, with other like copper-plated and dead carbon brushes, give an attractive appearance to the whole. Around the base of this structure are arranged copper-plated and bare electric light carbons of all sizes, together with larger carbon electrodes for electro-metallurgical purposes. Upon either side are smaller structures, the bases of which are of similar material to that of the central one. On the south a castle has been constructed of electric light carbons held in by side walls of large battery plate carbons. The base upon which this rests is also composed of carbon rods and plates; and distributed here and there are other forms of carbon, both bare and plated. To the north is a structure somewhat simpler, displaying in an attractive manner the various shapes which are produced in this now most useful article of commerce, which but a few years ago was scarcely known in the arts.

Hanging in the front and rear of the display are two enormous carbon electrode rods 24 inches in length and 3 inches in diameter, and at the north and south hang other rods of same length, but lesser in diameter, both, however, electroplated.

EXHIBIT OF THE NATIONAL CARBON COMPANY.

THE EXHIBIT OF THE HOMACOUSTIC APPARATUS COMPANY.

The Homacoustic Apparatus Company is showing in the

British section of the Electricity Building its appliances in operation. The Homacoustic device, patented in America, Europe, Australia and other countries by Mr. H. A. Cutmore, does away with many objectionable features of the old-fashioned speaking tubes, the whistle being automatic and there being no necessity of changing the tube from mouth to ear, and vice versa during conversation. A few inches beyond the mouthpiece into which the speaker talks is a cock, in which is a plug leading to a flexible tube, at the end of which is an ear cup, the arrangement being such that when the ear cup hangs down the passage to the mouthpiece is closed, and when raised to the ear the passage is opened, and the voice from the speaker at the distant end of the tube comes through the flexible tube to the listener. Just beyond the ear tube connection, in the top of the main tube, is a connection with a globular metallic air chamber, in which is a rubber bulb and whistle, a plunger working vertically in the top of the chamber; and by pressing with the hand upon this plunger, as shown in one of the views, the usual call or whistle is sent to the distant end of the tube. By means of a switch plate, shown in another view, the operator may be placed in communication with any number of other rooms without the multiplication of flexible tubes, mouthpieces, whistles, etc. The lower plate of the switch is rigidly fixed to a given number of speaking tubes, and on it revolves an upper plate provided with whistles and indicator shutters corresponding with the different tubes, the upper plate being revolved by a small knob to connect with any of the different tubes through which a call may have been received or it may be desired to talk. The throwing back of the shutter, as shown, indicates the tube through which the call comes, and the pressing upon the plunger sends the call when the proper connection has been made. The improvement can be readily fitted to existing speaking tubes at small cost.

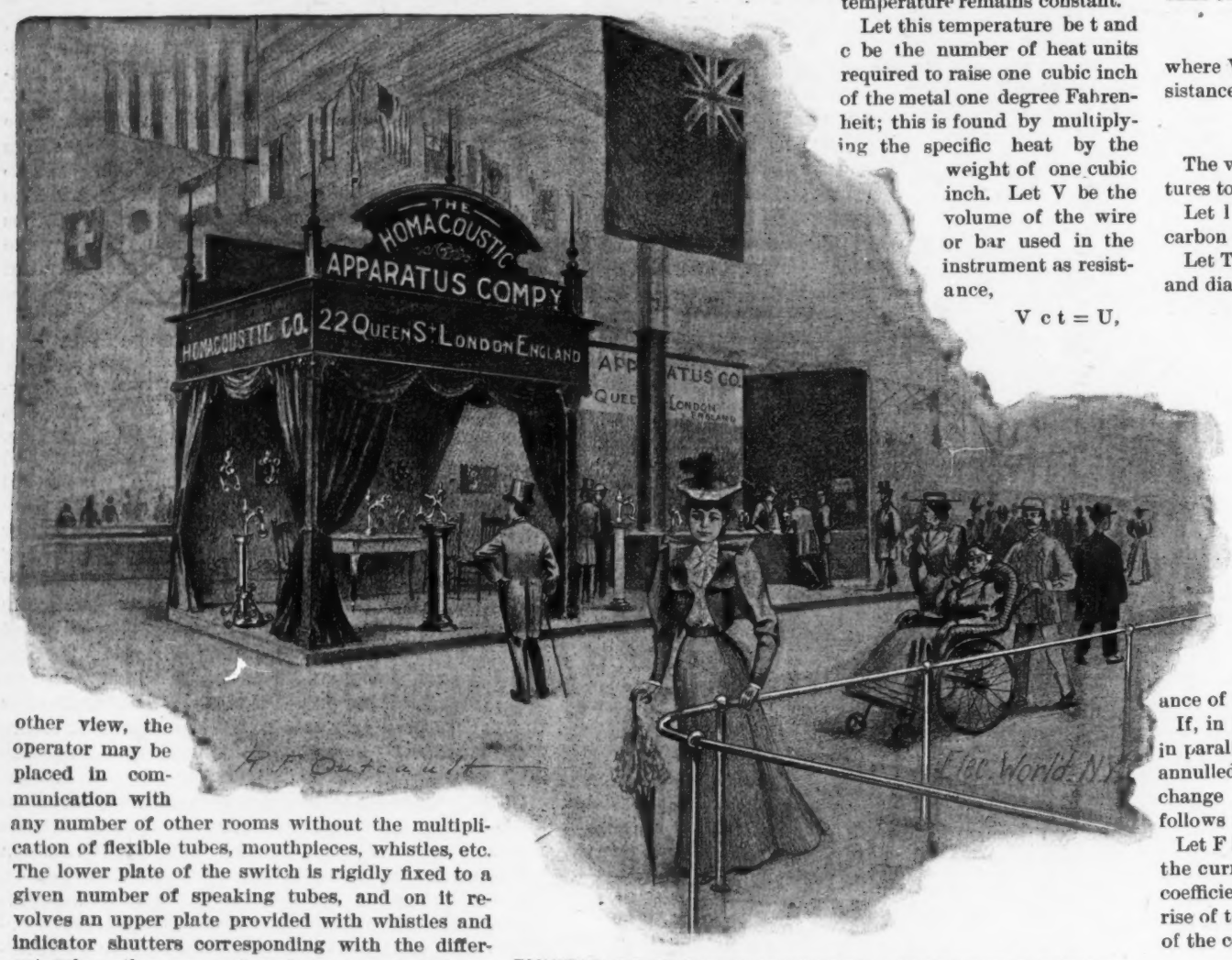


EXHIBIT OF THE HOMACOUSTIC APPARATUS COMPANY.

This speaking tube is made with different attachments for a variety of uses—being furnished with a suitable pedestal for fixing on the floor by the side of a desk, novel tube connections for use under a desk or on a wall behind a chair, and double ear tubes for use in factories, machine shops, etc., where there may be an unusual amount of noise. A form of instrument has also been especially designed for use on board ship in connection with a system of electric signals.

One of the Constant Current Machines.

The display of this company is in charge of Mr. H. C. Byshe, who is kept busy answering questions in regard to this apparatus, which, although so well known abroad, is new here.

Temperature Error in Electrical Instruments.

BY W. M. HILL.

A prolific source of inaccuracy in electrical instruments is temperature error. This phenomenon manifests itself at very unexpected times and places, and causes many electricians to fall from grace, for sometimes it is almost impossible to banish.

This troublesome malady may be cured in several different ways: First, by increasing the volume of metal which forms the constant resistance in the instrument; second, by introducing, in series with the resistance, some metal, such as carbon, whose temperature co-efficient is negative, or whose resistance decreases as the temperature rises; third, by introducing, in series, a small rheostat, which is altered as the temperature changes; fourth, by using some metal, such as constanton, whose temperature co-efficient is zero.

To increase the volume of the metal used allow the maximum current A, which the instrument measures, to pass through the instrument until the metal rises to the maximum temperature; this point will be reached when the temperature remains constant.

Let this temperature be t and c be the number of heat units required to raise one cubic inch of the metal one degree Fahrenheit; this is found by multiplying the specific heat by the weight of one cubic inch. Let V be the volume of the wire or bar used in the instrument as resistance,

$$V\,c\,t = U,$$

where U is the number of heat units given to the metal by the passage of the current.

Suppose that a rise of n degrees in temperature will alter the resistance so little that no perceptible difference is observed in the reading of the instrument,

$$\frac{U}{nc} = V_1,$$

where V_1 is the volume to which the resistance metal must be altered.

Let d be the diameter and l the length of the piece of metal of volume V_1, and let R be the constant resistance.

Let T be the resistance of a piece of this metal of diameter d_1, and the length l_1, which may be found from the resistance tables.

$$\tfrac{1}{4}\pi\,d^2\,l = V_1$$

$$\frac{T}{R} = \frac{d^2\,l}{d_1^2\,l}$$

$$d = \left(\frac{T\,d_1^2\,V_1}{\tfrac{1}{4}\pi\,l_1\,R}\right)^{\frac{1}{4}}$$

$$l = \frac{\sqrt{V_1\,l_1\,R}}{\sqrt{\frac{\pi}{4}\,T\,d_1^2}}$$

Let $d = 1$ and $l = 1$, then

$$d = \left(\frac{T\,V_1}{\frac{\pi}{4}\,R}\right)^{\frac{1}{4}}$$

$$l = \frac{\sqrt{V_1\,R}}{\sqrt{\frac{\pi}{4}\,T}}$$

The metal which is substituted of volume V_1 should be adjusted to the resistance R, on account of the difference in purity, which may exist in the metal. The space available in the instrument manifestly puts a limit to the use of this method, as the instrument must be compact and portable. This method does not compensate for changes in the temperature of the air.

To compensate by carbon, let m be the temperatur coefficient of carbon, that is the percentage of decrease of resistance for a rise in temperature of one degree Fahrenheit, and m_1 the coefficient of the German silver or other metal used as resistance. Allow the maximum current to pass through the metal until the maximum temperature is reached. Now it is necessary to substitute for part of the resistance a piece of carbon of such volume that its decrease of resistance for temperature it will equal the increase of the German silver.

Let R be the resistance required in the instrument and F be the resistance in carbon which is substituted for part of this; let b be the increase in resistance of the German silver for a rise of temperature equal to t°, this German silver being that actually to be in series with the carbon.

$$(R-F)\,m_1\,t^\circ = b.$$

$$F\,m\,t^\circ = b.$$

$$F = \frac{R\,m_1}{m + m_1}$$

Let the maximum current pass through a piece of carbon of resistance F and volume V_1 until the maximum temperature t_1 is reached; let g be the heat units required to raise one cubic inch of carbon one degree Fahrenheit.

$$\frac{V_1\,g\,t_1}{g\,t} = V,$$

where V is the required volume of a piece of carbon of resistance F which is to be substituted, or

$$\frac{V}{V_1} = \frac{t_1}{t}$$

The volumes are inversely proportional to the temperatures to which they are to be raised.

Let l be the length and d be the diameter of a piece of carbon of volume V and resistance F.

Let T be the resistance of a piece of carbon of unit length and diameter.

$$d = \left(\frac{T\,V}{\frac{\pi}{4}\,F}\right)^{\frac{1}{2}}$$

$$l = \frac{\sqrt{V\,F}}{\sqrt{\frac{\pi}{4}\,T}}$$

After the carbon has been connected up in series with the German silver the whole resistance is carefully adjusted; as the connection, etc., may have altered it, and the small change for adjustment will not materially change the compensation. This method can only be used in instruments of high resistance, if the fixed resistance be desired in one piece, for the resistance of carbon is rather high.

If, in instruments of low resistance, the carbon be put in parallel, as may be suggested, the error is only partially annulled, as a different value of F is required for every change of temperature. This may be illustrated as follows:

Let F be the resistance of the compensating carbon, G the current going through the carbon, m the temperature coefficient of carbon, m_1 the coefficient of copper, t the rise of temperature, A the whole current, S the resistance of the copper, and R the fixed resistance.

$$S = \frac{G\,F}{A - G}$$

$$\frac{(S + m_1\,t)\,(F - m\,t)}{S + S\,m_1\,t + F - F\,m\,t} = R$$

$$G = \frac{A\,R}{F}$$

$$F = \frac{R\,m_1 + R\,m}{m_1 - m\,m_1\,t}$$

It will be seen that, for a change of t, there will be a small change in the value of F. Therefore it would be better in low-resistance instruments to construct the fixed resistance of a great number of small wires connected in parallel, each wire being compensated by its own piece of carbon. If a piece of carbon of rectangular cross section be used, the equations for cross section and length are:

$$S = \sqrt{\frac{T\,V}{F\,l_1}} \qquad l = \sqrt{\frac{V\,F\,l_1}{T}};$$

where T is the resistance of a piece of carbon of length l, and unit cross section. The formulas for carbon are not in use, as far as is known; but they compensate for external as well as internal rises of temperature.

The compensating rheostat is exemplified in the temperature corrector of Weston's A. C. voltmeter; this rheostat may also be adjusted for external and internal temperature changes. It consists of a small rheostat with coils of very fine wire, having a disc marked in degrees to correspond with those of a thermometer, whose bulb is in the instrument box; around this disc a pointer is moved, cutting out coils as the temperature rises; each degree corresponds to the rise of resistance for one degree Fahrenheit.

Constanton is an alloy recently put upon the market, and is manufactured in Germany; with 40 per cent. of nickel, it has a temperature coefficient of zero; with 41 per cent. it has a small negative coefficient, and with below 40 per cent. it has a small positive coefficient. Its resistance is 30 times copper, so that, on account of this high resistance, its use is limited to either bulky or high resistance instruments. It is quite expensive but has many advantages when used as a shunt, separate from the instrument. Constanton is quite easily drawn; but while doing this it is necessary to anneal it frequently, as it becomes unmalleable.

Theory of the Transformer.*—V. †

BY F. BEDELL AND A. C. CREHORE.

In the previous section of this article the transformer diagrams were given, showing the variation of the different quantities when the primary current was maintained

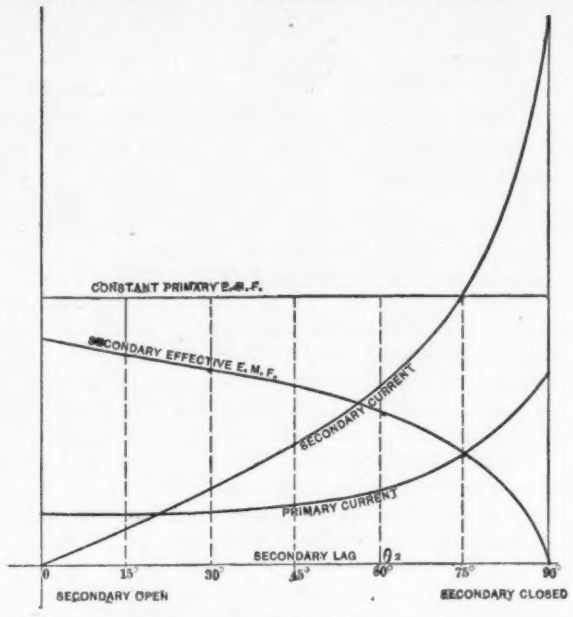


FIG. 13.—E. M. FS. AND CURRENTS FOR DIFFERENT VALUES OF SECONDARY ANGLE OF LAG Θ_2 AS R_2 IS VARIED. TYPICAL CASE.

constant and the secondary resistance varied. It is our present object to show how these quantities change when the primary is subjected to a constant impressed electromotive force and the secondary resistance is varied, and to give diagrams, as before, illustrating both a typical and a particular case.

PROBLEM II.—The primary impressed electromotive force is maintained constant while the secondary resistance alone is varied. It is required to find how all the other quantities are affected.

This problem will perhaps carry more interest with it than the former, because the common system of transformation is the constant potential system. In order to follow the plan which we propose, however, it is necessary to understand the constant current diagrams first, since we depend upon these for the solution in the constant potential system.

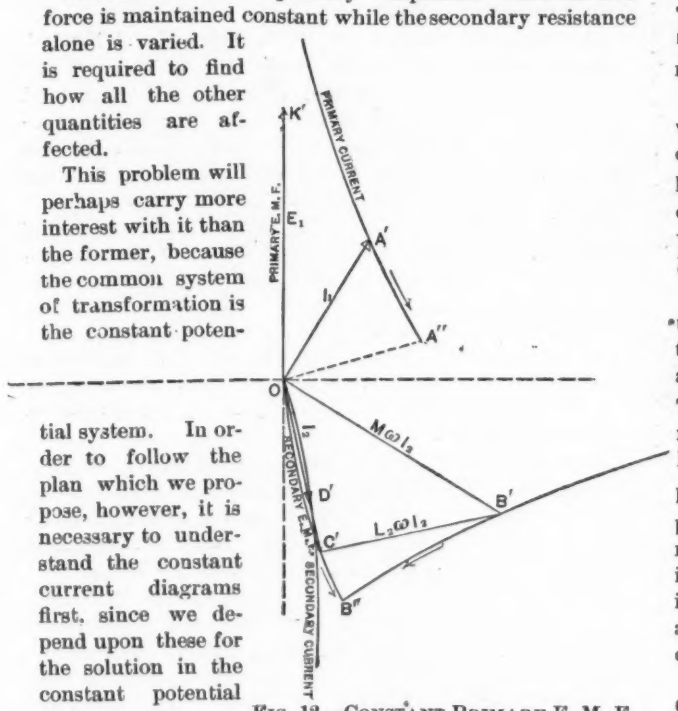


FIG. 12.—CONSTANT PRIMARY E. M. F. POLAR DIAGRAM. R_2 VARIED. TYPICAL CASE. SECOND METHOD. PRIMARY E. M. F. CONSTANT IN MAGNITUDE AND DIRECTION.

In Fig. 11 is reproduced the transformer diagram Fig. 4. The same letters used in Fig. 4 are used here to designate the corresponding points. For example, $\overline{O\,A}$ denotes the constant primary current, O C B the secondary E. M. F. triangle, etc.

It has been shown that the primary impressed E. M. F. varies upon the semicircle H K J when the primary current is constant and secondary resistance varied. Now, if we do not consider that the primary current is constant, suppose we change it to some other value, and draw the diagram again for this new value. We should find that every line of the new diagram had changed in magnitude proportionally to the change in the primary current, and all the angles had remained unchanged. This process is equivalent to either magnifying or reducing the whole diagram proportionally as the primary current changes. This will be evident when we consider that no angle depends upon the primary current, and that the primary current is a factor in the magnitude of every line, so that to double the current is to double every line in the diagram, without changing their relative positions.

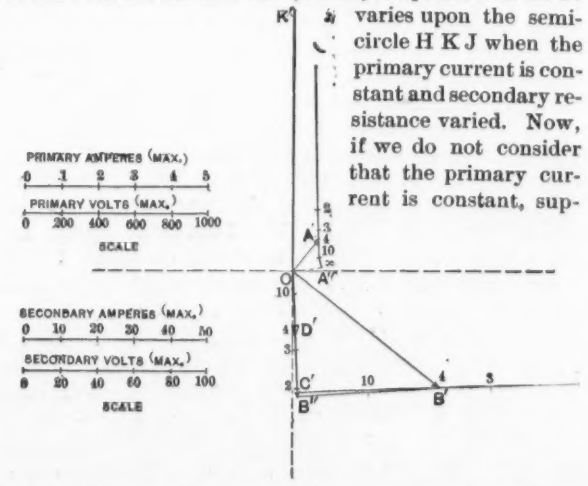


FIG. 16.—PRIMARY E. M. F. CONSTANT IN MAGNITUDE AND DIRECTION. ACTUAL CASE. TEN-LIGHT TRANSFORMER. DATA GIVEN UNDER FIG. 15.

We may magnify the diagram profitably in two ways. First let us suppose that the primary E. M. F. $\overline{O\,K}$ is changed to $\overline{O\,K'}$, which is the constant E. M. F. we intend to furnish the transformer. Every other line in the diagram must be changed proportionally, and $\overline{O\,C}$ becomes $\overline{O\,C'}$, $\overline{O\,D}$ becomes $\overline{O\,D'}$, etc. If the diagram is so changed for every value of the secondary resistance, *i. e.*, for every position of the lines, and $\overline{O\,K}$ is always changed to a constant value $\overline{O\,K'}$ in the same direction as each particular value of $\overline{O\,K}$, we have the diagram represented in Fig. 11. Here the primary E. M. F. lies upon the arc of a circle J' K' H', having O as its centre, and is therefore constant in magnitude. The primary current $\overline{O\,A'}$ has a constant direction, but varies in magnitude along the line $\overline{O\,H'}$.

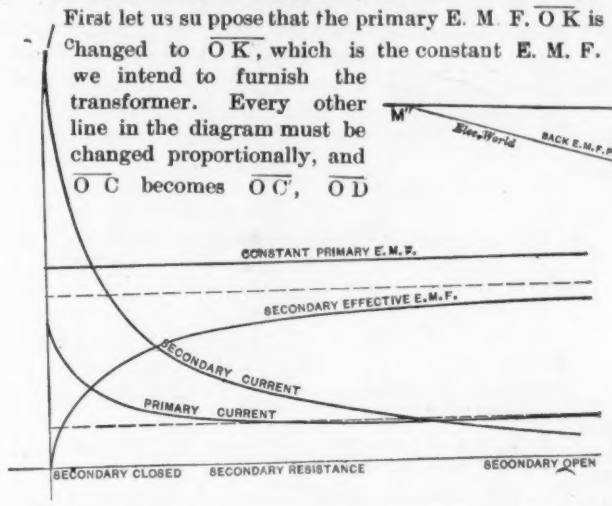


FIG. 14.—E. M. FS. AND CURRENTS FOR DIFFERENT VALUES OF R_2. TYPICAL CASE.

The secondary E. M. F. lies upon the curve O C' B'', which rises more abruptly than the semi-circle near the origin, and descends more gradually to B''. Upon that portion of the curve near B'', it is evident that the secondary E. M. F. vector $\overline{O\,C'}$ keeps nearer to a constant value for a considerable distance than does the E. M. F. $\overline{O\,C}$ in the semi-circle.

When we consider the diagram Fig. 15 for an actual transformer, this curve O C' B'' coincides approximately throughout a long range with a circle having O as a centre, and the secondary E. M. F. is, therefore, nearly constant. The smaller the line $\overline{O\,H}$ in comparison with $\overline{H\,J}$, the more nearly will the secondary E. M. F. be similar to the primary E. M. F. Usually the primary resistance is very small compared with the self-induction, so that $\overline{O\,H}$ is small compared with $\overline{H\,J}$, and consequently the curve O C' B'' is nearly a circle similar to J' K' H', and the secondary E. M. F. is approximately constant. That this is so nearly constant in this case is partially due to the fact that these diagrams are based upon the consideration of a constant coefficient of self-induction, that is, the magnetic medium is perfect.

The secondary current, instead of lying on the semi-circle O D L, now lies upon the curve O D' L'': which starts out from the origin in the direction of $\overline{O\,B}$, but turns rapidly away toward L''.

In the actual transformer diagram Fig. 15, the point L'' is very far removed in the direction of $\overline{O\,L}$, so that the current curve is here nearly parallel with the line $\overline{O\,L}$.

The back E. M. F., represented in Figs. 11 and 15 by the curves O F' M'', is similar in shape, but 90 degrees behind the secondary current curves.

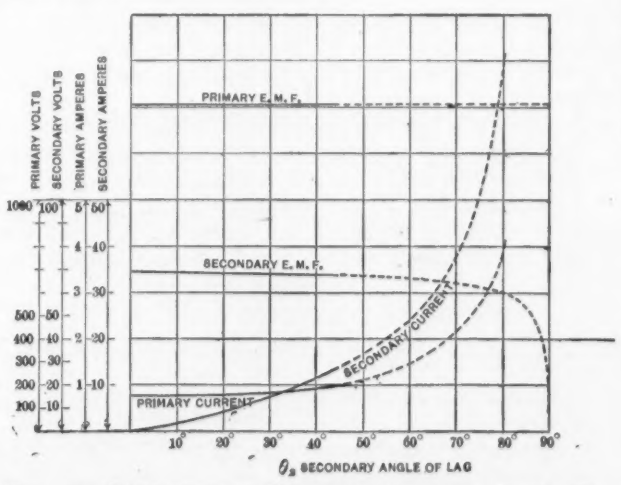


FIG. 17.—RECTANGULAR DIAGRAMS SHOWING E. M. FS. AND CURRENTS FOR DIFFERENT VALUES OF SECONDARY LAG AS R_2 IS VARIED. ACTUAL CASE. TEN-LIGHT TRANSFORMER.

The transformer for which the curves in Figs. 15, 16, 17 and 18 are drawn is a ten-light transformer in which $L_1 = 1.96$ henrys; $L_2 = .0047$ henry; $M = .096$; $R_1 = 50$ ohms; $R_2 = .1$ ohm. The curves for constant primary current are drawn for a current of one ampère, virtual or square root of mean square value, or 1.414 maximum. The curves for constant primary E. M. F. are for 1,000 volts virtual, or 1414 maximum. In Fig. 15 the numbers 1, 2, 3, 4, etc., indicate the value of the secondary resistance for that point on the curve.

The second method of magnifying the diagram, which may present some additional advantages, inasmuch as it

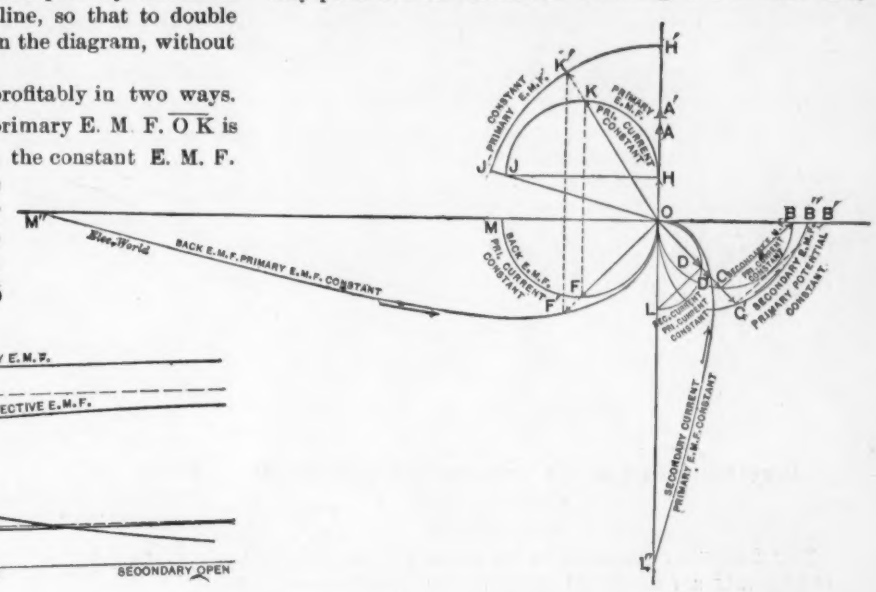


FIG. 11.—CONSTANT PRIMARY E. M. F. POLAR DIAGRAM OBTAINED FROM CONSTANT CURRENT POLAR DIAGRAM, R_2 VARIED. TYPICAL CASE.

makes the constant potential diagram analogous to the constant current diagram, is shown in Fig. 12. Here the primary E. M. F. $\overline{O\,K'}$ is not only made constant in magnitude, as in Fig. 11, but also constant in direction, analogous to the constant primary current in the constant current diagrams. This figure is constructed from Fig. 11, by revolving each line in Fig. 11 through that particular angle which will bring the primary E. M. F. $\overline{O\,K}$ always into a constant position $\overline{O\,K'}$ arbitrarily selected.

The primary current, Fig. 12, evidently lies upon the curve A' A'' changing not only its angle with the E. M. F., but also its magnitude as the load increases. The point A' coincides with A'' when the load is nothing and the secondary is open-circuited.

The E. M. F. impressed upon the secondary $\overline{O\,B'}$, being always 90 degrees behind the primary current and always

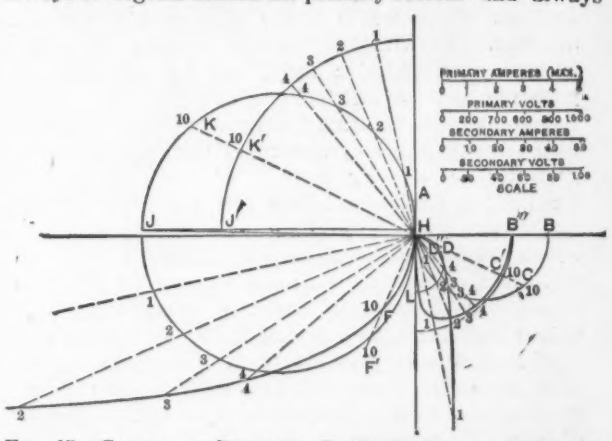


FIG. 15.—CONSTANT PRIMARY E. M. F. POLAR DIAGRAM OBTAINED FROM CONSTANT CURRENT DIAGRAM. ACTUAL CASE. TEN-LIGHT TRANSFORMER, $R_1 = 50$ OHMS; $R_2 = .1$ OHM; $L_1 = 1.96$ HENRYS; $L_2 = .0047$ HENRY; $\omega = 1{,}000$.

proportional to it, necessarily describes a curve B' B'' similar to the primary current curve.

The secondary effective E. M. F. $\overline{O\,C'}$ varies upon the curve $\overline{O\,C'\,B''}$, in the direction of the arrow, as the resistance increases. When the resistance is infinite and the secondary is open-circuited, the points B' and C' move to B'', and $\overline{O\,B''}$ is the largest value of the secondary E. M. F.

The secondary current lies upon the curve $\overline{O\,D'}$ and bends slightly in the opposite direction to the E. M. F. curve O C' B'', but the current always remains nearly 180° behind the primary E. M. F. $\overline{O\,K'}$.

Fig. 16 shows the transformer diagram for an actual

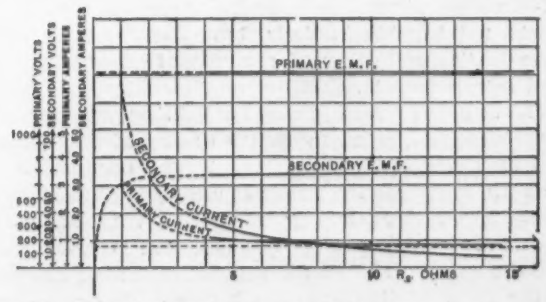


FIG. 18.—RECTANGULAR DIAGRAM SHOWING THE E. M. FS. AND CURRENTS FOR DIFFERENT VALUES OF R_2. ACTUAL CASE. TEN-LIGHT TRANSFORMER.

case, the curves being drawn for the same 10-light transformer as in Fig. 15, the numbers 1, 2, 3, 4, etc., indicating, as before, the secondary resistance. The secondary current is almost 180 degrees behind the primary E. M. F. It is to be noticed that the *locus* A A' of the primary current is nearly a straight line parallel with the line O K'.

* All rights reserved.

† For the previous sections of this article see THE ELECTRICAL WORLD, May 27, 1893, page 390.

From the polar curves already described we can construct curves plotted with rectangular co-ordinates, showing the relations between the magnitudes of the various quantities, neglecting their direction. Fig. 13 is thus constructed directly from Fig. 11, and shows the primary and secondary E. M. Fs. and currents for various values of the secondary angle of lag, θ_2, for this typical case. Fig. 17 is similarly constructed, for an actual case, from Fig. 15. The heavy portions of the curves represent the variations within the working range of the transformer, the dotted lines showing these curves extended beyond the limits of practice.

Fig. 14 shows, in rectangular co-ordinates, the values of the various quantities as a function of the secondary resistance, and is a typical case constructed from the polar diagram in Fig. 11.

Fig. 18 is the same for a 10-light transformer and is constructed from Fig. 15. The heavy portions of the curves indicate, as before, the actual range of the transformer, and the dotted curves are extended beyond the working limits. It is seen how constant the secondary E. M. F. is within these limits.

(To be continued.)

Long Distance Electric Transmission of Power.*

BY W. F. C. HASSON.

The following paper is in no sense purely technical, but is only a formulated reply to the questions—What distance may power be transmitted? What is the efficiency of the transmission? What is the cost of transmission?

The possibility of reversing the "generator" or "dynamo," as it is generally called, and utilizing it as a "motor" was definitely recognized in 1873. Since then the advance in methods of construction, systems of regulation, etc., has been great and along many lines, and dynamos and motors of many types have reached a high state of efficiency. The advance was so rapid that it certainly seemed possible that methods of insulation would be so perfected as to render possible the employment of continuous currents of any desired electromotive force.

So many difficulties appeared in the way of making satisfactory alternating current motors that the attention of successful electricians was directed almost entirely to the perfection of those operated by the continuous current. The high cost of fuel in many possible mining and manufacturing districts promised a large field for the employment of electric machinery, at least in cases where water power was within reasonable distance. Notwithstanding this demand the advance of power transmission machinery by no means kept pace with that of electrical machines for other purposes.

Continuous current machinery was soon brought to a high state of efficiency and regulation, and furnished a perfectly satisfactory method of transmitting power for limited distances where low electromotive forces might be economically employed. As the relations between electromotive force and strength of current and their connection with the amount of power generated were better understood, it became evident that, unless high E. M. F. was employed, the cost of copper would practically prohibit the transmission of power long distances. The continuous current has strong advocates who do not hesitate to say that large amounts of power may be successfully commutated and distributed at an electromotive force of 5,000 or 6,000 volts. However, the large corporations that manufacture electrical machinery have not sustained the confidence of the public in these statements by furnishing commercial machines constructed on these lines. In fact, the company that has actively opposed the use of alternating current machinery now states that, in the present state of electrical science, there is a definite limit to safe commutation far below that required, and that if an attempt is made to generate heavy continuous currents at such high voltages the machines will inevitably break down.

So broad a statement, concerning the final perfection of any electrical system, may to-day be accepted with a fair amount of doubt. So firm is the belief of this particular company, however, that during the past year it has brought to a state of commercial perfection an alternating current system.

Notwithstanding the difficulties, certain able enthusiasts, notably Nikola Tesla, have devoted their entire time to the perfecting of commercial alternating current motor systems.

The transmission of power, for lighting purposes only, may be accomplished by means of any of the commercial alternating current systems. The generators furnish an electromotive force sufficiently high to allow an economic distribution of power over several miles. By means of transformers an electromotive force of 10,000 volts is easily obtained for transmission long distances to the point of distribution, where reducing transformers supply a safe pressure for local circuits. The success of this system is evidenced at San Antonio, Cal., where a transmission of 28 miles at 10,000 volts is now in operation.

The electrical manufacturing companies of America have been so engrossed in developing and exploiting their lighting and railway systems that they have apparently in the past given little serious attention to the perfection of systems to meet the needs of electrical power on the Pacific Coast, and they have given still less consideration to the circumstances which render its employment possible.

These, briefly stated, are: 1. A vast mountain range, extending the entire length of the coast, where the accumulation of the winter snow creates a great and constant supply of water power under high heads. 2. A country full of mineral resources. 3. A country where manufacturing industries are still in their infancy. 4. A country practically devoid of coal. *5. That, in the vicinity of many paying mines, the forests have been destroyed, and the cost of transporting fuel renders the operating of the mines unprofitable. 6. That in many cases available water power is within reasonable distance of these mines. 7. That power exists within distances ranging from ten to forty miles of many fairly large towns, where it may be profitably utilized for supplying lights, the operation of electric railways, and the furnishing of mills with power. 8. That the further development of water power for the generation of electric power will not only build new manufacturing cities, but the distribution of the water will make fertile large tracts of land.

During the past year, however, the question of long distance transmission has been extensively discussed, and the best energies of the electrical companies have been devoted to its satisfactory solution.

The result is that three alternating current systems in various stages of commercial perfection are now before the public. These are: 1. The single-phase, or popularly called synchronous system. 2. The two-phase or di-phase system. 3. The three-phase or tri-phase system. The first of these systems has been commercially perfected to meet certain requirements. It is admirably adapted to the transmission of power that is to be used for the continuous operation of motors of not less than 30 h. p. Its success has been exemplified in the machinery that has now been in operation almost two years at Telluride, Colo. Machinery for the transmission of power thirteen miles to operate the mills of the Standard Consolidated Mining Company is now being installed at Bodie, Cal.

The single-phase motors are not self-starting, and hence there are many circumstances that they do not easily meet. Self-starting non-synchronous motors are promised to the public, but until this promise is realized the field of this system is limited.

The second and third systems, comprised in the term multiphase, are more comprehensive, and undertake to furnish power for multifarious purposes as follows: 1. The direct operation of incandescent lights. 2. The operation of ordinary arc light machines by self-starting motors. 3. The operation of alternating current arc lights under certain conditions. 4. The operation of continuous current arc lights from rotary transformers. 5. By means of rotary transformers to furnish continuous current for the operation of the ordinary railway motors. 6. The operation of self-starting stationary motors of all powers, ranging from one-eighth to five hundred horse power. The fulfillment of these promises will certainly meet all demands.

The promoters of these two systems each claim great individual advantages, but, until they have been submitted to the test of commercial operation, the only claims that may be admitted are that the three-phase system requires less copper wire for transmission, and that the two-phase is somewhat more simple and better adapted to meet the possibility of a perfected single-phase motor.

Within three months a three-phase plant for the transmission of 300 h. p. will be in operation at Redlands, Cal. Within less than a year one of these systems will be installed for the transmission of 3,000 h. p. twenty miles, under the guarantee that it will meet requirements for all varieties of power, and that the efficiency of transmission from generator axle to point of distribution will be at least 79 per cent.

I may say that this matter has been gone into very thoroughly in the proposed Folsom-Sacramento transmission. The result is that an electric plant will be in operation within a year to supply a vast power for a great variety of purposes in Sacramento. I regret that I am not at liberty to give you the figures in this case.

(To be continued.)

*Abstract of a paper read before the Technical Society of the Pacific Coast.

* In a plant that will shortly be in operation for transmitting power 13 miles, the total cost of electric and hydraulic machinery, together with their erection, will be less than $40,000, and the annual saving in fuel will be $40,000.

Electrical Notation—Abbreviations and Symbols.

Our attention has been called by M. Hospitalier to an error in his original table of symbols, which was also reprinted in The Electrical World of June 10, 1893. In the formula for the intensity of magnetization, the small m in the numerator should have been an old English capital, so that the formula, instead of reading $\mathfrak{I} = \frac{m}{V}$, should have been $\mathfrak{I} = \frac{\mathfrak{M}}{V}$.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Current Produced by Mechanical Pressure.—The Lond. "Elec. Rev.," May 26, gives a short abstract of a paper by Dr. Gore, published in the "Phil. Mag." on the "Relation of Volta Electromotive Force to Pressure, Etc." Long vertical tubes, about three metres in length and one centimetre in diameter, were filled with electrolytes and provided with terminals of the same kind of metal at the two ends; on connecting the two electrodes a current was produced for a number of different solutions and electrodes; the experiments were tried under varying conditions, most of them showing a current in the same direction, a few in the opposite direction, and some no current at all. The current was a permanent one; its amount is not given, but it is presumably only an exceedingly small one. His experiments show the current to be due to the difference in pressure on the two electrodes, and he thinks the original cause must lie in some change of the potential motion of the molecules. Some work must necessarily be done in the act of producing the pressure, and this work may increase the energy of molecular motion. If pressure alters the direction or velocity of molecular motion, it may act as a permitting condition, so as to enable some of the unceasing motion of the molecules to expend itself in producing a permanent current as such motion does in a voltaic cell. This is offered as a reasonable explanation. Contraction of total volume by chemical union, being a yielding to pressure, may contribute to the result in the present case. Pressure on one of the electrodes produced by other means caused a generation of current. All other possible causes for the production of current were eliminated in the tests.

Influence Machines.—The Lond. "Elec. Rev." May 26, describes a new Wimshurst machine, as follows: "Take a double Holtz machine and divide each of the fixed plates into two by cutting it through the notched openings for the paper tongues. Turn the fixed plate through a quarter revolution until the field plates are vertical, which will enable the neutralizing brushes to be supported on the pillars which support the collecting brushes, and dispense with a separate neutralizing rod. The paper tongues, which replenish the field plates, are to be replaced by metallic brushes. Small metallic brushes are to be substituted for the collecting combs, and the whole is to be inclosed in a glass case to exclude dust and moisture." It is thought that this machine would not give quite so large a quantity per revolution as the old Holtz machine.

Loss of Charge in Diffused and Obscure Light.—A translation of Mr. Branly's paper, mentioned in the Digest of May 27, is published in the Lond. "Electrician," May 26, under the heading, "On the Dissipation of Electricity by Diffused Light and in the Dark."

Thermal Radiation in Absolute Measure.—A translation of the paper on this subject, mentioned in the Digest Feb. 25, is given in abstract in the Lond. "Electrician," May 26.

Electro-magnetic Theory of Color Dispersion.—Von Helmholtz publishes a paper on this subject in the "Wied. Ann.," page 389.

MAGNETISM.

Magnetic Curve Tracer.—The Lond. "Electrician," May 26, contains an article by Prof. Ewing on the latest form of his new curve tracer. This instrument was described and illustrated in The Electrical World, Aug. 20, Oct. 8, and Dec. 10, 1892. The present form appears to differ but little from that shown in the last reference, except that the magnet containing the iron to be tested is a simple U-shaped magnet, with parallel arms of circular cross-section, instead of being a bent rectangle; this simplifies its use very greatly. Other minor improvements have been made, which practice has shown to be desirable. The object of this instrument is to test the magnetic quality of samples of iron by the tracing of a curve which connects the magnetization B with the magnetizing force H. The form now appears to be such that it can readily be used as a commercial instrument, similarly to a tensile strength tester, by means of which manufacturers of iron can determine the magnetic properties of iron as readily and as definitely as its tensile strength or other similar mechanical qualities. He recommends tracing the curves slowly by reversing the current by hand, thus obtaining a number of points, say, on a translucent piece of paper, which are then connected to form the curve; this eliminates the time lag.

Magnetic Viscosity.—The paper mentioned last week is reprinted also in the Lond. "Elec. Eng.," May 26.

Magnetic Properties of Bodies at Different Temperatures.—"L'Elec.," May 13, contains a note on this subject by Mr. Curie.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Imperial Physical Technical Institute of Germany.—The Lond. "Electrician," May 26, reprints a short ab-

stract from the report to the Reichstag on the work accomplished by this Institute. Among the electrical researches may be mentioned the tests with the Violle-Siemens unit of light, namely, the amount radiated by one square centimetre of platinum at its melting point. It proved to be very difficult of practical adoption; the block of platinum was precluded by the difficulty of maintaining it pure during melting, and platinum foil was apt to tear at the critical moment. They therefore determined on a temperature below the melting point, and to measure this temperature by the ratio of the total energy radiated to that transmitted by a layer of water contained in a vessel with plain parallel quartz sides, a ratio which was found to be constant for a given temperature and to vary rapidly on heating or cooling; the amount of radiation to be measured by a delicate bolometer. In measuring arc lights the light was reduced by an Aubert sector, a revolving disc which can be adjusted to cut off a definite portion of the light. Two illuminated patches were thrown side by side on a screen, and the sector adjusted until the boundary vanished. For different colored lights the boundary was adjusted to its greatest indistinctness.

Congress Proposals.—The "Elek. Zeitschrift," May 26, reprints in full a well prepared report of a committee of the Elektechnischer Verein (the leading electrical society of Germany), on the proposed work of the Congress as suggested by the American Institute's Committee. Regarding the unit of illumination, it states that the Violle unit has not been experimented with sufficiently to be used as a fundamental standard. The Imperial Institute's researches have shown that it cannot be used, except with bars of platinum melted electrically, and whether even in this case it becomes possible to rely on it, has yet to be determined; for these reasons the committee does not approve of basing secondary standards on it. The Imperial Institute has lately found that an apparently very constant unit can be based on the electrical incandescence (not the fusion point) of platinum foil, but it is not sufficiently well adapted to reproduction to be used as a standard in practice. The committee recommends the Hefner lamp in the exact proportions as determined by the inventor. In this form it has been tested during four years by the Imperial Institute, and found to be absolutely reliable. To change its dimensions would require these lengthy tests to be repeated. Other proposed light units have neither been tested nor defined with sufficient accuracy. The Siemens unit was found to be too variable. The Hefner lamp is the only light unit which has been tested sufficiently and which can be defined with great accuracy. The committee, therefore, proposes to reject the proposals and to adopt the Hefner lamp as a provisional practical unit, and to base secondary units on it.

It does not approve of the definition of impressed electromotive force. It states that the province of a congress is limited to the determination of units, and not to the definition of physical quantities, etc. It refers to a number of these definitions, and states that they are specifically English and therefore do not concern an International Congress. It therefore rejects the definition of the terms "inductance," "reluctance," "inductivity," "reluctivity," etc. It excepts the definition of a north pole, of which it approves. It approves very decidedly of the proposition not to change the ampere and farad; also, not to name the unit kilowatt hour an ampere hour. It approves of the suggestions for the concrete units, offering only the suggestion not to define the volt and watt, as in the American report, but to say merely that all the electrical units are to be based on that ampere and that ohm. It claims that it is not within the province of an International Congress to determine the value of a B. A. unit in terms of the ohm, as this is a mere matter of measurement. It objects to the definition of the Matthiessen standard, which, it says, no one can define so long as one cannot state what constitutes soft copper. (In this respect they have evidently misunderstood the American proposals, as mentioned before in these columns. The definition has nothing to do with the specific resistance of copper, but refers merely to a definition of the Matthiessen standard.) Regarding the temperature coefficient of the Clark cell, it suggests saying: The temperature coefficient is with sufficient approximation equal to 0..... Regarding the designation "true amperes," "true ohms," etc., it does not think there is any necessity to take any action on these, because in an analytical work the true units are understood, the few who are concerned with the true values will make themselves clear without any formal instructions from a congress.

It approves of the establishment of a unit of conductivity, but objects to the word "mho," and suggests instead the name "thomson." Regarding the name "henry" it makes no objections, stating, however, that they think there is no particular need for a specific name for the quadrant. In this connection it suggests that the names "gauss" and "siemens" should be used when names are required in the future for some other units. Regarding the magnetic units, it objects to the introduction of a new set of units, as the system at present in universal use, namely, the C. G. S. units, is perfectly satisfactory. It claims that "6,000 lines of force per square centimetre" is preferable to ".00006 gauss," as the former explains itself, while the latter requires additional knowledge regarding the meaning of that name (but this objection might be made to all the electrical units at present in use). The connecting link between the ampere-ohm system and the magnetic C. G. S. system is the ampere-turn, which offers no difficulties, as every one knows that an ampere is equal to one-tenth of a C. G. S. unit. It therefore concludes that the C. G. S. system for the magnetic units is a truly "practical system," and that there is no need for another.

Regarding the proposal made in this country to define a 2,000-c. p. arc lamp, the Lond. "Elec. Rev.," May 26, approves of the suggestion to define such lamps by the current, voltage and the watts. It expresses a doubt, however, whether it will be approved by those who pay for the light, for, as in the case of gas, they will be likely to think that the "quality" of the electricity has something to do with the brightness of the light.

Hummel-Schuckert Meter.—In "L'Elec.," May 13, Mr. Meylan, who has given much attention to the subject of meters, describes this meter and gives the results of some investigations made with it. As is well known this meter resembles very closely the well known Elihu Thomson meter, differing from it only in some details; an electromagnet instead of permanent magnets is used to dampen the motion of the rotating disc; there is an additional coil in the fine wire circuit, the action of which is like, and is added to, that of the series coil which produces the field for the revolving armature; the object of this coil is to develop sufficient torque to overcome the mechanical friction; the copper damper is not in the form of a disc, as in the Thomson meter, but consists of a fine ring carried on radial arms; the field of the damping magnet may be regulated by moving the iron armature of the electromagnet to or from the poles, thus permitting one to vary the velocity so as to make the reading correspond directly with the kilowatt hours. In his tests he finds that the energy consumed by a ten-ampere and 110-volt meter is 10.4 watts, which he says is excessive; the loss of volts is .9, which, he says, is three times as great as that in other meters which he has examined. He gives tabulated data of tests made with different voltages and different currents in order to test the indications; he finds that the meter is over-compensated, and therefore indicates too much for a small current, and if tapped lightly will even run without a current in the series coil; at low voltages the damping magnet is too much dependent on the variation in the volts; its accuracy cannot be depended upon to more than 5 per cent.; he concludes that Thomson's damping method with permanent magnets is preferable, provided they remain constant; also because the meter is then applicable for alternating currents; he calculates the counter E. M. F. and the torque, and concludes that the Thomson meter is much better proportioned; the magnetic field in the former is so weak that the earth's field may affect as much as 3 per cent. which he considers a great fault. A short note regarding this article is contained in the Lond. "Electrician," May 19.

Electrolytic Meters.—The Lond. "Electrician," May 26, reviews this subject editorially without, however, giving anything new.

Ampere Meter without Permanent Magnets.—The "Elek. Zeitschrift," May 5, reprints a somewhat lengthy paper by Dr. Koepsel. He discusses at some length the theory of a new form, the object of which is to avoid the action of the current in cross-magnetizing the permanent magnets, and to make the deflection independent of external currents. This is accomplished by placing the poles of the permanent magnet in a slot or opening made in the conductor itself, the magnetic needle indicating the deflection being placed outside of the conductor; astatic action is obtained by duplicating this arrangement, as it were, by doubling the conductor on itself in a zizag fashion somewhat like the letter S; the ampere meter is intended for strong currents; illustrations which explain themselves are given.

Portable Measurer of Magnetic Fields.—The Lond. "Elec. Rev.," May 26, mentions an instrument for measuring field strength by means of a portable coil; it is an inversion of the d'Arsonval galvanometer, the torque required to suspend a coil carrying a constant current, parallel to the direction of the field, giving a measure of the field strength; the current is furnished by a dry cell; it is sufficiently sensitive to measure the magnetization of watches; it is described in the proceedings of the Physical Society.

New Photometer.—Mr. Mesnard, before the French Society of Physics, described a photometer consisting of a glass tube open at both ends and surrounded by an opaque tube; the tube is pointed to the light to be measured; the light passing through it is neutralized at the other end by absorbing screens of different thicknesses, whose absorbing power is known; when this light is completely absorbed, its intensity is calculated from the thickness of the absorbing screen which is required to neutralize it; in one form of the apparatus this absorbing material is made of a liquid which is slightly tinted; this is run into the tube until the light is neutralized, and from the height of the column the amount is determined; liquids of different degrees of translucency may be used for different intensities of light, in the same instrument; the instrument must, of course, be first calibrated by means of some known standard of light. The instrument is mentioned in "L'Ind. Elec.," May 25. (It does not seem that this could be a very reliable or accurate instrument, as the adjustment must depend greatly on the condition of the eyes of the observer; that is, whether they have been exposed to light or to darkness just prior to the test. The writer suggested this same instrument a number of years ago, but abandoned it for the reason just given.)

DYNAMOS, MOTORS AND TRANSFORMERS.

Prevention of Sparking.—The Lond. "Elec. Eng.," May 26, gives a discussion of Mr. Sayers' paper on the prevention of sparking, abstracted in the Digest last week. Prof. S. P. Thompson said that Mr. Sayers had succeeded in doing what others had only tried to do. Mr. Swinburne thinks that this paper will be looked upon as the greatest advance in the design of direct current dynamos during the last ten years. Mr. Housman spoke of the importance of the surface resistance between brush and commutator, which, he says, is ordinarily only one four-thousandths of an ohm per square inch, but was often three or four times this. Mr. Mordey thinks this is the most important paper on direct current dynamos since that of Hopkinson in 1886. Mr. S. F. Walker was not enthusiastic about it, and said there were many difficulties in the way of the practical accomplishment; there would be a great amount of heat confined in a narrow space. Prof. Ayrton claims to have suggested the idea together with Prof. Perry some years ago; in orthodox circles field and armature were opposed when they ought to help each other. Mr. Snell feared that difficulties would arise in other than the Pacinotti type of armature; he had tried toothed armatures, but had to go back to smooth cores; the compound coil was in the wrong place, it could be controlled in the fields, but not in the armature; he looked forward to the entire abrogation of the commutator on dynamos and motors. Prof. Forbes stated that he had seen a similar device used in this country by Mr. Eickemeyer in experimenting with alternate current motors. Mr. Siemens said the device introduced complications and extra expense; with ordinary construction they could make sparkless dynamos without change of brushes for any load. Mr. Mordey stated that the device enabled one to approximate the direct current dynamo to a transformer by doing away with the air space which costs money in energy; the ampere turns were reduced from thousands to hundreds and the armature current was used for excitation; he agreed that sparkless dynamos were now already produced, but at a great cost of copper; the real point was getting rid of air space and saving copper without losing sparklessness. Mr. Crompton thought that the whole matter was one of expense, and asks what the comparative weight of material and amount of copper was. Mr. Sayers' reply is not yet published.

Armature Reaction.—A translation of the article, abstracted in the Digest, April 1, is reprinted in abstract in the Lond. "Electrician," May 26, in which also most of the figures are given.

Dynamo and Engine Test.—The English journals of May 26 give a short description of recent tests made with a Castle dynamo with bi-polar U-shaped field, and Willans engine, accompanied by an illustration. The two machines are on the same base plate and have their shafts coupled; the dynamo output is 125 volts and 1,025 amperes at 350 revolutions; the electrical efficiency is said to be over 97 per cent., the commercial efficiency 94 per cent. and the ratio of the electrical horse power in the external circuit to the indicated horse power in the cylinders at full load, was found to be over 86 per cent., which it is thought will increase to 87 after running several minutes.

An Early High Frequency Alternator.—The Lond. "Electrician," May 26, calls attention to the fact that Pulvermacher in 1849 invented an alternator which had a frequency of several thousand periods per second, the armature having 40 poles; both field magnets and armature were made of laminated iron and the air-gap was made exceedingly small; no other description is given.

Alternators in Parallel.—Mr. Yeaman, in the Lond. "Elec. Rev.," May 26, referring to a statement (see Digest last week) that the Lowrie-Hall installations were the only ones in England where parallel running was regularly practiced, shows that this is not the case; he mentions that Mordey, Ferranti and Gray are running alternators in parallel.

Series Traction Motors.—Mr. Dallas' article is concluded in the Lond. "Elec. Rev.," May 26. He discusses briefly the subject of pinions, lightning arresters, car wiring and controlling apparatus. His statements seem to be based on American practice, which is already well known in this country; some of the arrangements described are now superseded by others which he does not describe.

Transformer Design.—In Mr. Weekes' serial in the Lond. "Elec. Eng.," May 26, he gives full data and instructions for designing a six-kilowatt transformer of the shell type for a ratio of 2,000 to 100 and a frequency of 100.

Choking Coils and Hysteresis in Transformers.—Prof. Perry, before the London Physical Society states that a choking coil may be regarded as a transformer with one

primary and many secondaries, represented by the conducting masses; the secondaries could be replaced by a hypothetical single short-circuited coil; from some mathematical deduction he is inclined to believe that there is no hysteresis in transformers.

TRANSMISSION OF POWER.

Electricity in Agriculture.—The Lond. "Elec. Rev.," May 26, summarizes the reports of the foreign consuls to the United States Senate regarding the application of electrical power in agricultural operations. The results in almost all cases show that practically no use is as yet made of electrical power, and therefore the information gives little satisfaction. Regarding the influence of the electric current on vegetation, the reports from Germany appear to be decidedly adverse; no results are given in that notice.

The Lond. "Elec. Eng.," May 26, mentions a plant in England in which electric power is used for various farming purposes. Among other things there is a root extractor consisting simply of a motor driving a capstan for drawing a rope attached to the root; it is said to take about 25 h. p. The installation is said to be an interesting example of the application of electric power to country work.

RAILWAYS.

Elevated Road in Naples.—The Lond. Elec. Eng.," May 26, gives a short description of a novel proposed road in that city, built on viaducts and commencing at a height of 325 feet thence to the foot of a second tower 490 feet high, and from the top of this to the other terminal, which is the top of a hill forming part of the town and at present difficult of access. The same car is to be drawn up in the form of an elevator in the towers and then propelled along the road so that no change of cars is required.

Train Lighting.—"L'Elec.," May 20, gives a short description, including some illustrations of the system adopted by the Paris-Lyons-Mediterranean Railroad. Besides some few details shown in the cuts, there appears to be little of novelty in it.

Yorkshire Station.—The Lond. "Elec. Eng.," May 26, concludes its description of this station in Leeds, mentioned last week. The description is short and is devoted largely to the boilers and engines. It is accompanied by four large working drawings of the station.

WIRES, WIRING AND CONDUITS.

House Wiring.—The "Elek. Zeitschrift," May 19, describes and illustrates a new system of internal wiring, devised by Mr. Peschel. It consists essentially of grooved porcelain rings, which are threaded on the wire and which are then held in position on the walls by ornamental hooks which embrace the rings over a little more than half the circumference, and, being slightly elastic, enable the porcelains to be slipped into them after the hooks have been secured to the walls. For supports inserted after the wire is strung, the porcelains are made in two halves. For gripping the wire a special arrangement is used, in which a wedge key in the porcelain is pressed against the wire. The illustrations in the original are sufficiently clear to explain themselves. Numerous advantages are claimed, among others that the system, besides being much cheaper and simpler, is quite decorative, as the wires may, if desired, be left to sag instead of being rigidly straight. The fastenings may be secured without injuring the paper and decorations. New houses may be provided with the hooks, the actual wiring being left to be done when it is needed. The system seems to have merits, and is worth the attention of those interested in the subject.

Fault Indicator.—The article abstracted in the Digest, May 27, is translated and reprinted in abstract in the Lond. "Electrician, May 26, together with the diagrams.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Burglar Alarm.—A very simple alarm, devised by Mr. Townley, mentioned in the Lond. "Elec. Eng.," May 26, consists of two spring contacts separated by a thin wooden wedge attached by means of a cord to the window sash, door, etc. Any slight motion withdraws the wedge and starts the alarm.

MISCELLANEOUS.

Electrical Treatment of Cancer.—The Lond. "Elec. Rev.," May 26, discusses this subject editorially. It gives reasons for thinking that some good could be done in alleviating pain and sometimes minimizing the growth and chance of relapse, but that the complete cure of undoubted cases by its aid is by no means established, at the same time there appears to be no reason why it should not be established in the future. The problem is to destroy a group of cells without destroying the whole body; none of the methods appear so far to have met with more than partial success; it quotes a number of authors to show that electricity undoubtedly alleviates the pain of cancer; it appears that cancer cells are more easily destroyed by the electric current than healthy cells; physicians should find out how the killing is performed, that is, what function of the electric current is most productive of fatal effect on the cells.

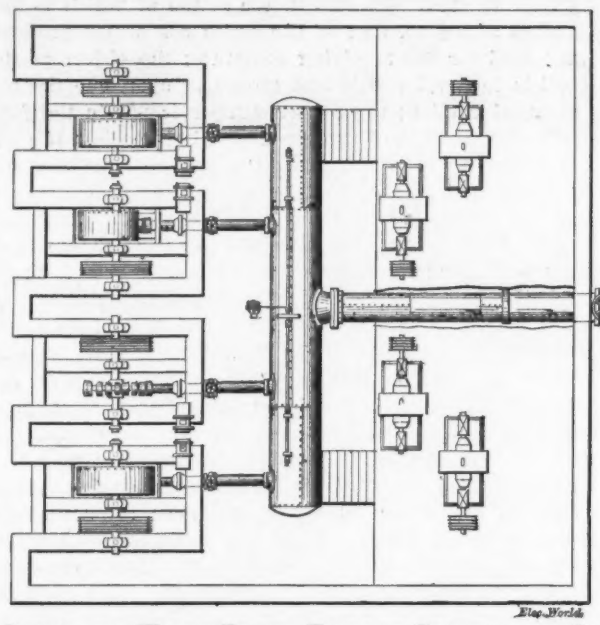
Thermopiles.—The Lond. "Elec. Eng.," May 26, mentions a new form of Guelcher thermopile constructed in Germany giving 3.5 volts and 3 amperes, costing about $40, and consuming gas at the rate of one cent. per hour; no further description is given.

Steam from Slag.—The Lond. "Elec. Eng.," May 19, in a note, refers to an experiment in which the heat of slag is utilized for the generation of steam, without the water coming in contact with the slag. The molten slag runs into receptacles, communicates its heat to the water and when solid is knocked out; 100 lbs. steam pressure was produced, but the quantity of slag used is not given.

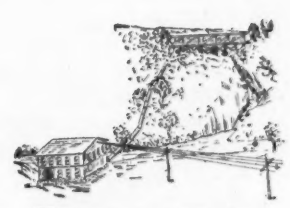
A Water Power Electric Transmission Plant.

The accompanying illustrations show the power plant which is being installed by the Pelton Water Wheel Company, of San Francisco and New York, for Moodie's Gold Mining and Exploration Company, Limited, for the purpose of operating various classes of machinery used in its different mines. The plant is designed to utilize the water of the Queen's River, near Barberton, South African Republic.

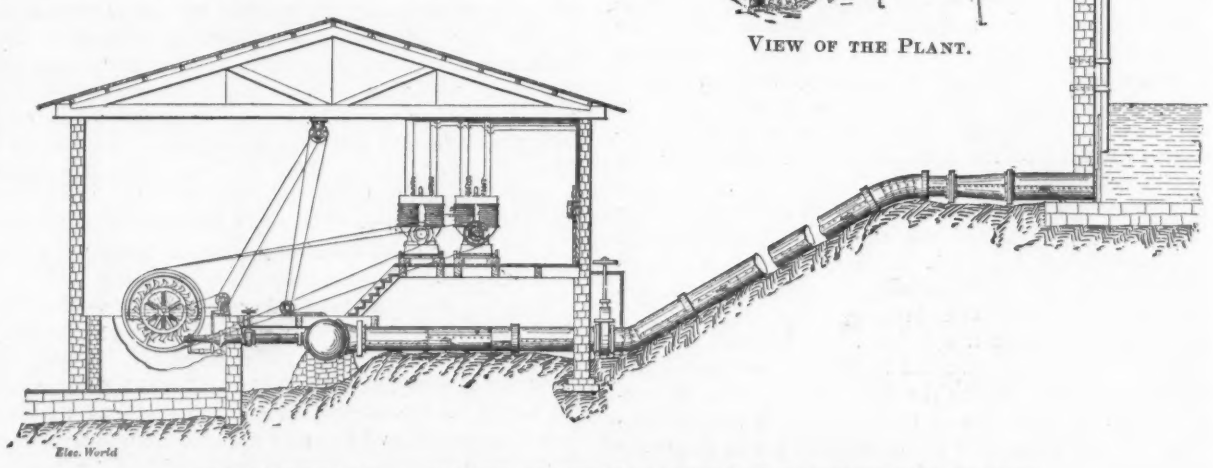
There are six mines on its claim, which require power for mining and reduction purposes. These mines are situated within a radius of four miles from the generating station. The capacity of the plant will be 500 h. p., which is developed by four Pelton wheels, with a capacity of upward of 125 h. p. each, running under 142 feet effective head.



PLAN OF A WATER POWER ELECTRIC TRANSMISSION PLANT.



VIEW OF THE PLANT.



ELEVATION OF A WATER POWER ELECTRIC TRANSMISSION PLANT.

The minimum flow of the Queen's River is 2,300 cubic feet per minute, and the surveyed head is 150 feet. The water is diverted from the river in the usual way by a ditch and flume, and from this flume a pipe line extends down the grade a distance of 510 feet, as shown in the cut.

The arrangement of the pipe line is as follows: The first third of the line, which is connected to the forebay or pressure box, is 30 inches in diameter, and made of No. 12 Birmingham gauge steel; the next third, 28 inches in diameter, made of No. 14 steel, and the balance, 26 inches in diameter, made of No. 14 steel. The lower end of the main line terminates in a receiver, which distributes the water to the several wheels. The loss of head by friction in the above arrangement of pipe line is 8 feet while carrying sufficient water for 500 h. p. This leaves 142 feet effective or running pressure. The pipe is double riveted in the longitudinal seams, the same kind that is extensively used in California and the Rocky Mountains mining districts.

The water wheels are six feet in diameter and make 150 revolutions per minute. They are fed by single nozzles of the Pelton deflecting type. The nozzle tips through which the water supply is discharged are 4¼ inches in diameter, and vent 575 cubic feet of water per minute each, the combined power of the four wheels being 500 h. p. The speed of the wheels is controlled by a Pelton differential governor, which operates directly upon the deflecting nozzles. The dynamos are four in number, and are driven direct from water wheel shaft by sheaves six feet in diameter, each sheave grooved for five 1½-inch diameter cotton ropes.

These illustrations give a very good idea of the construction of electric transmission plants adapted for high and medium falls.

Electric Heating and Cooking.

The early history of the electrical arts is filled with instances of branches that have been retarded in their development by claims, reasonable enough, as subsequently shown, but based at the time upon no accomplished facts. The American public is impatient of mere theoretical considerations unaccompanied by practical demonstrations, and the many claims for electric heating and cooking have largely been disregarded on account of the crude apparatus that has so often been offered in evidence instead of the commercial forms that are alone convincing. These considerations, no doubt, have had an influence in directing the wise course of the American Heating Corporation, of Boston, Mass., which has quietly been working, without public announcement, at perfecting, not only in a technical, but in a commercial sense, apparatus to cover almost every conceivable application of electricity to heating and cooking. Having acquired control of various fundamental patents relating to this art, and finally developed in a practical form the numerous domestic and other applications, they have now entered the market and are prepared to meet the demand that the merits of their wares will doubtless create.

We recently had the pleasure of visiting the main offices of the company and inspecting the apparatus on view, and noted in particular the careful manner in which the various details have been worked out, as well as the ingenious methods by which the processes have been applied to a great range of uses.

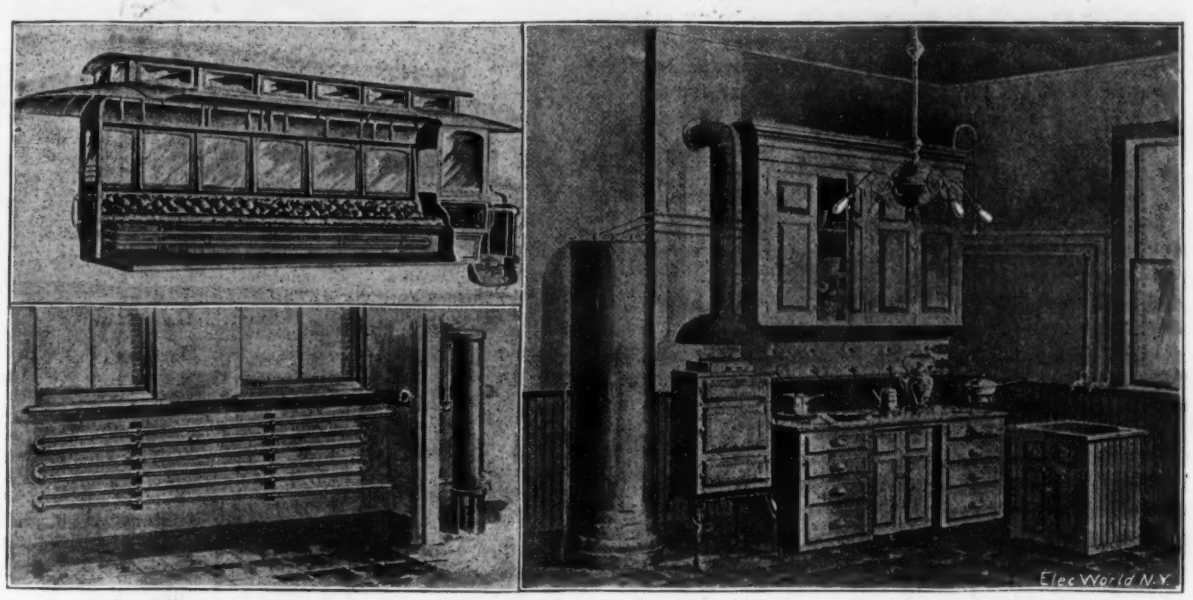
Under the head of heating apparatus for buildings there are several different forms of apparatus. Of these the radiators are not unlike steam radiators in general appearance, and possess, of course, the great advantage of not requiring costly and inconvenient piping, besides insuring safety from damage through leakage, and are easy to manipulate, a small switch controlling the heat. By means of the fluid circulation system, which we illustrate, existing methods of piping and radiators can be adapted for steam, hot water or other fluids, the only change being in the substitution of a simple electric boiler, conveniently placed, for the ordinary boiler. The hot air system devised by this company admits of remarkable elasticity. Each room may be heated entirely independent of all the other rooms, and, by the addition of an electric fan, the air pipes in an extended system may be reduced to a minimum size. For portable or permanent use there are electric stoves that are as neat in appearance as they are efficient in action.

The great attention that its importance demands has been paid to electric car heating, and all the United States patents, it is claimed, relative to car heating by electricity have been acquired. The systems include all the well tested methods and apparatus, whether by the direct circulation of hot air, or by the radiation of heat from suitable pipe surfaces. The accompanying cut illustrates the location and arrangement of apparatus according to one method, for heating an electric car.

Under the head of electric heating for industrial purposes there are numerous applications, and none of these will be more appreciated than the long list of irons, which comprises tailors', hatters', and laundry irons of many different sizes and designs, seaming and soldering irons and even electric curling and crimping irons. Other applications in this department are glue pots, crucibles, mufflers and cigar lighters.

Undoubtedly the most interesting department is that

devoted to electric household and cooking utensils. When it is considered that about 95 per cent. of the electric heat applied is actually utilized in this system of apparatus against perhaps only five per cent. by the ordinary method, that the discomfort of cooking is minimized or entirely removed and that the heat is applied in the most efficient manner for each case, it will be realized that the



ELECTRIC HEATING AND COOKING.

advance in this direction amounts to a revolution, and doubtless will be accompanied, owing to the absence of disagreeable features in its new practice, by a corresponding advance in the art of cookery itself. We illustrate a model kitchen that brings out in a strong light the great change created in this department of the household by the new art. The hot water service tank boiler and an oven occupy the left-hand place. On the top of the oven is seen an electric broiler doing its work, while the steam and fumes of the cooking pass up the overhanging flue. On the locker slab are seen a variety of the more commonly used utensils—a plate stove, a spider, a coffee pot, teakettle, and a chafing dish. These are connected to the circuit through the switchboard, shown above the slab, and each utensil can be instantly put in or out of use independently of the others by a small switch. No unpleasant heat is radiated from these utensils, all heat being utilized solely for the work to be done.

Three sizes of ovens are manufactured, and so designed that the exteriors never become hot, all the heat being utilized inside in the most effective manner; the meats, cakes, etc., are cooked extremely evenly as a consequence, and in less time than by the ordinary method. Among other kitchen utensils are steam cookers and farina boilers, while the ease with which the heat

THE HILL ROTARY FAN MOTOR.

may be applied to secure the best effect will probably very largely increase the list.

All of these interesting utensils are now being placed on exhibition at the various offices of this company throughout the United States, and the public will thus be given an opportunity to judge for itself the newest conquest of electrical science. In our issue of June 3 we gave the cost of using the various apparatus as compared with the ordinary methods, from which it appears that electric heating is not, as often asserted, handicapped in this respect.

Several sub-companies have been organized in different sections of the United States for the purpose of manufacturing and vending electric heating appliances under the above patents. Among these companies are the New England Electric Heating Company, of Boston, and the Central Electric Heating Company, of New York City.

The Hill Rotary Fan Motor.

We illustrate a novel fan motor recently placed on the market by the W. S. Hill Electric Company, 183 Oliver street, Boston, Mass., which includes several interesting features. The motor proper is mounted on a stationary base in such a manner that the side action of the fan rotates it, the rapidity of rotation being controlled by a crescent-shaped rudder which may be placed at any angle, and thus offer more or less resistance. This enables the best results to be obtained from a fan, as a large body of air is thus agitated and circulation provided for with the least discomfort. A rotating motor set in the centre of a large room will keep the air in motion in all parts of the room without any objectionable drafts when near the motor, and yet making its effects plainly noticeable in the remotest corner.

The motor, it is claimed, is perfectly noiseless, runs perfectly cool, is self-lubricating without the use of oil, and will run continuously for a whole season without any care. The fan is 12 inches in diameter, and runs at a speed of 1,500 revolutions per minute on a 110-volt circuit with less than one ampere of current, it is claimed.

The Tice-Lintner Potential Indicator.

The improved form of the Tice-Lintner potential indicator, manufactured by the Tice-Lintner Electric Company, Minneapolis, Minn., as recently placed upon the market, is shown in the accompanying illustration, and while not differing materially from the original instrument, contains several improvements that go to make

THE TICE-LINTNER POTENTIAL INDICATOR.

it a most perfect indicator. The advantages accruing from close potential regulation are so obvious that it is unnecessary to dwell at length upon them. Repeated tests with high efficiency lamps have been made with this instrument, resulting, it is claimed, in every instance in increasing the life claimed for the same. The Tice-Lintner potential indicator combines, with a voltmeter of the highest degree of accuracy, permanency and dead beat qualities, an alarm attachment of equal reliability, which immediately attracts the attention of the attendant to any change or variation in pressure, and the same is remedied before any damage ensues to the lamps or motors on the working circuits. Aside from the alarm, the especial features of the instrument are the entire lack of permanent magnets, or any other deterioriating element, and the fact that it can be operated in the close vicinity of intense magnetic fields without disturbing the accuracy of its readings.

The "Cyclone" Fan Motor.

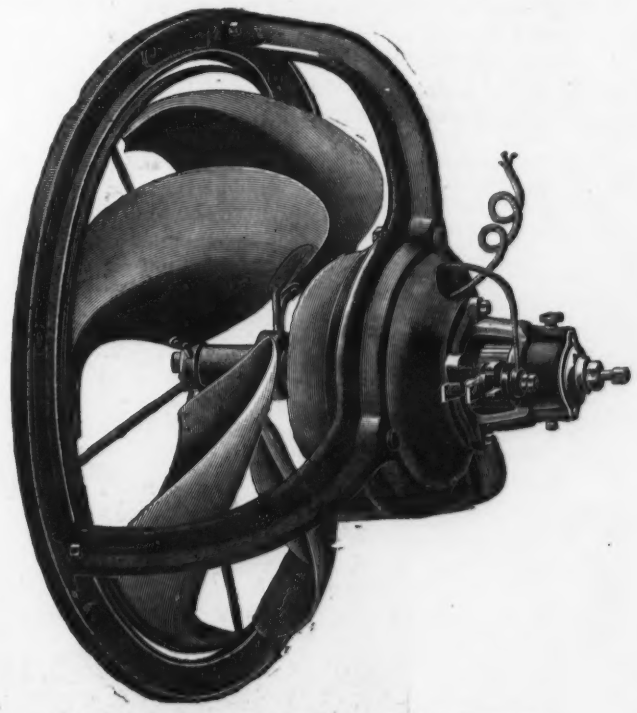
The Standard Electric Company, of Philadelphia, Pa., has recently placed on the market a fan motor for direct current, styled the standard "Cyclone." In appearance it is one of the most artistic motors on the market. It is thoroughly ironclad, and almost absolutely noiseless. Its construction is simple, yet very effective, requiring .8 of an ampere at full speed. The regulating device is attached to the base, where three speeds may

THE "CYCLONE" MOTOR.

be easily obtained by turning the regulating knob. For a long time there has been a demand for an ornamental fan motor for office and domestic use. In the "Cyclone" there is a combination of beauty, economy, efficiency and freedom from rasping and humming noises. It is claimed that it possesses unequaled advantages.

The Lundell Exhaust Fan Outfit.

We herewith illustrate a new outfit placed on the market by the Interior Conduit and Insulation Company, 44 Broad street, New York City, which is a combination of an ordinary exhaust fan directly coupled to a slow speed Lundell motor. The absence of belting and the absolute noiselessness of the outfit are particularly noticeable. An illustration of the adaptability of this outfit is found in the installation in the restaurant of Busse & Simoni, Delmonico's old place in New street. Guests sitting directly underneath the fan do not notice that it is running. The location of the fan is novel and serves a double purpose—it exhausts the air from both kitchen and restaurant, and gives com-



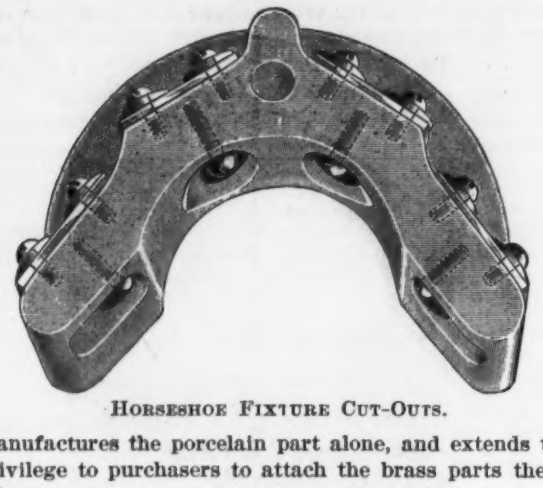
THE LUNDELL EXHAUST FAN OUTFIT.

fort to both guests and chefs. This ventilating outfit is adapted for all places, and is a sure means of keeping the air in a pure and wholesome condition.

Horseshoe Fixture Cut-Out.

The accompanying cut illustrates a new horseshoe fixture cut-out manufactured by the Imperial Porcelain Works, Trenton, N. J., and patented by Mr. Frederic A. Duggan, the proprietor of the above works. The advantages claimed for this cut-out over any other at present on the market are: its simplicity in construction, and the cheapness with which its brass parts can be assembled, requiring, as the reader will observe, no bending whatever of these, thus reducing the cost of the brasses, it is claimed, one-third below any other fixture now on the market. Referring to the cut it will be seen that

the porcelain surfaces on which the brasses fit are flat, and that only one screw is used for each plate, which is prevented from turning by the projecting rim. The cut-out, either with or without the brasses, is covered by a patent, but the Imperial Porcelain Works Company



HORSESHOE FIXTURE CUT-OUTS.

manufactures the porcelain part alone, and extends the privilege to purchasers to attach the brass parts themselves.

Automatic Safety Switch and Rheostat.

For the protection of stationary motors on railway and power circuits the General Electric Company has devised an automatic safety switch and rheostat, which takes the place of the ordinary double-pole switch and starting rheostat.

The rheostat proper consists of resistance wire wound upon spools of incombustible material, which are fastened to the back of the switch base. The latter is supported by the iron box, which incloses the spools. On the front of the switch base are mounted the switch contacts, the switch arm and the automatic releasing mechanism. The switch is made up of two segments of a metal ring, to which the line wires are connected, two sets of resistance points arranged on arcs of a circle just outside of and concentric with the line rings, and a switch arm, carrying a brush at each end, which makes connection between the line rings and the resistance points on the same side of the switch arm. A spiral spring tends to return the switch arm to the off position, and it can be left in the on position only when the motor is running under normal conditions.

Two electromagnets govern the automatic action of the switch. One of these, known as the detent magnet, is connected in series with the field coils of the motor, and governs a detent pin, which holds the switch arm in the on position after starting the motor, so long as the field current is maintained in the magnet. The other magnet, called the relay magnet, is in the main circuit, and controls an armature, which, when attracted, short-circuits the detent magnet.

In case the circuit is opened for an appreciable length of time the current in the detent magnet ceases, and the switch arm being released flies round to the off position. If the field circuit of the motor is broken, the switch arm is released, and the motor is shut down.

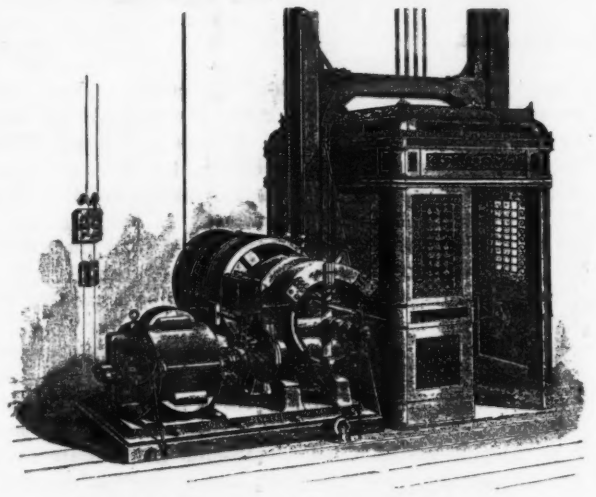
The Morse Direct Electric Elevator.

The machine shown in the accompanying illustration, which is built by Morse, Williams & Co., Philadelphia, New York, New Haven, Boston, Chicago, Scranton, Pa., and Washington, D. C., has been designed especially with a view of obtaining simplicity of construction, accessibility of parts for repair and smoothness in running, the latter exceedingly important feature being attained by the use of the improved Hindley worm gearing, the manufacture of which they have made a specialty for years. The machine has a worm of bronze or steel and a wheel encased in an oil-tight housing; the thrust of the worm shaft is taken on hard-metal buttons revolving in oil.

The motor is attached to the worm shaft by means of a coupling. The worm shaft is provided with a powerful double-shoe brake, which is released by the action of an electromagnet and is applied by a weight. The special advantage of this arrangement is shown in case the electric current from any cause be cut off, as the brake would be instantly applied, thus stopping the machine. The brake is so constructed as to act as a governor in checking the descent of the car.

The drum upon which the cables wind is grooved in the lathe and keyed fast to the heavy shaft, to which the worm wheel is also keyed. This shaft is provided with stop collars and nuts arranged to stop the car at terminal landings, independent of the operator.

The slack cable stop arrangement is also a feature of



THE MORSE DIRECT ELECTRIC ELEVATOR.

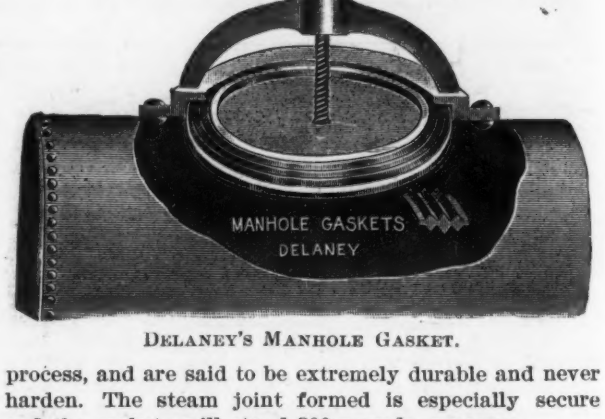
this machine; it stops the machine automatically in case the car should become obstructed in its descent and stop.

The motor is of the low speed, multipolar type; the bearings are self-oiling; carbon brushes are used, requiring a minimum of attention. The reversing switches and controlling apparatus are of simple and improved forms, their action causing the elevator to start easily and gently with and without a load.

The whole apparatus is placed upon a heavy cast-iron bedplate, and the motor is thoroughly insulated therefrom when a high tension current is used, to obviate danger of shock in the car. The efficiency of the machines has been tested under varying conditions, and the makers claim that the average amount of current consumed, both in raising the load and lowering the empty car, has been found to be remarkably small. These machines are designed to raise average loads at speeds as high as 250 feet per minute.

Delaney's Manhole Gasket.

The accompanying illustration gives a sectional view and the manner of applying the Delaney manhole gasket, manufactured by H. T. Delaney & Co., Third street, Milwaukee, Wis. The gaskets are made by a special



DELANEY'S MANHOLE GASKET.

process, and are said to be extremely durable and never harden. The steam joint formed is especially secure and the gaskets will stand 300 pounds pressure.

The "Acme" Portable Testing Set.

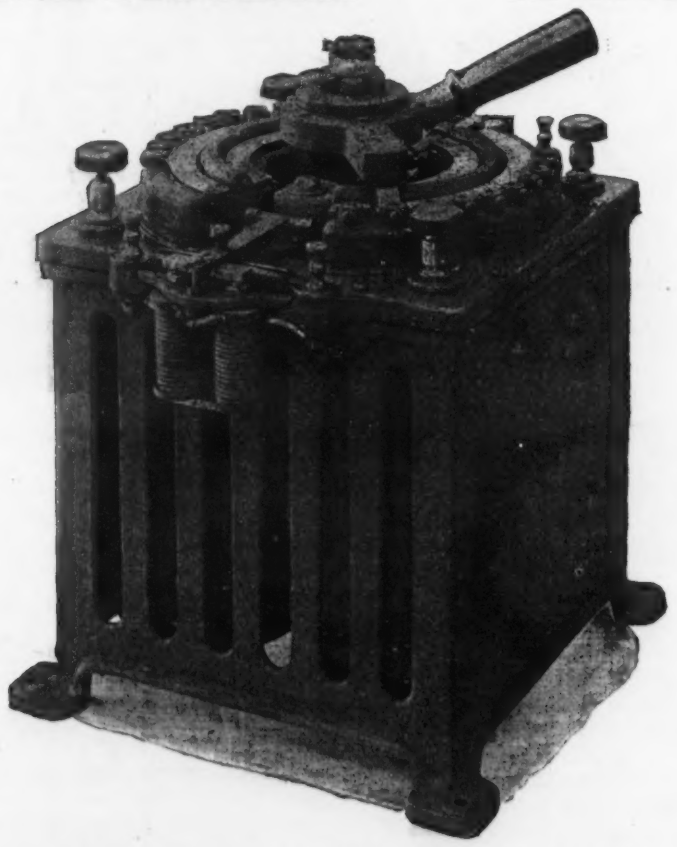
The portable testing set shown in the accompanying illustration is the result of long experience on the part of Queen & Co., Incorporated, of Philadelphia, in the manufacture of such instruments, and is a very convenient and perfect piece of apparatus.

It comprises a Wheatstone bridge, rheostat, D'Arsonval galvanometer, "Aluminium-Iodine" battery and double contact key, all contained in a handsome mahogany case of outside dimensions 8¼ inches by 5⅜ inches by 5 inches, and weighing less than 6 pounds complete. The leather case illustrated is very convenient when the apparatus is used by inspecting engineers, as it can be slung over the shoulder and carried as readily as a small handbag.

The coils in both bridge and rheostat are wound with platinoid wire, which long use has conclusively shown to be far superior to german silver, and adjustments are made with great care, an accuracy of one-fifth of one per cent. being guaranteed. The arrangement is similar to the "Post Office" design, with three coils in each bridge arm and 18 coils in the rheostat, giving a total range by means of the reversing attachment of from .001 ohm to 11,110,000 ohms.

The galvanometer is a modified form of the D'Arsonval type, made especially for the purpose. It is strongly built, hence not liable to injury, and is perfectly dead-beat, so that readings can be taken very rapidly. It is claimed that magnetic fields and mechanical vibrations produce no effect whatever, and the instrument will give as accurate indications in the street, on shipboard or in a dynamo room as in a college laboratory.

The battery is of the new "Aluminium-Iodine" form, with E. M. F. of 1 4-10 volts per cell, or equivalent to a total of 17 volts; this is practically 50 per cent. more than the ordinary chloride of silver cells. Should the battery be exhausted from long use, it can readily be removed from the box and renewed at slight expense.



AUTOMATIC SAFETY SWITCH AND RHEOSTAT.

THE "ACME" PORTABLE TESTING SET.

The switch also acts automatically to shut down the motor in case of dangerous overload.

By connecting push buttons to wires running from the detent magnet, the motor may be shut down from any desired part of the building. This is a very valuable feature, and it furnishes a means of stopping the machinery promptly in case of accident.

The apparatus is so very simple in operation that an inexperienced lineman can learn to use it in a short time. The great value of such an instrument will be evident to those who have used the forms heretofore obtainable, which usually necessitate the handling of two boxes, one for the rheostat, galvanometer and bridge, and a separate one for the battery.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 10, 1893.

Throughout the past week the bear traders have been attempting to make additional capital out of the depressed condition of affairs existing in business circles throughout the country. But the prices at which most stocks are selling for at the close of to-day's business on the Stock Exchange shows how futile their efforts have been. Wall street sentiment during the week has undergone considerable change. It is susceptible now to news of a favorable nature to the same degree that a week or two ago it was influenced by the feeling of distrust and disquietude that reigned everywhere.

General Electric has been attacked as strenuously as others. All sorts of rumors have been set afloat to bear this stock, but it has not sold under 70 and closes to-day at 73⅞, a rise in one day of three points. This practically offsets the attempts during the week to reach stop orders under 70. The change in sentiment regarding this stock has been brought about by Wall Street's belief that the affairs of the company have been misrepresented and that it is a good deal better off than many people have been led to believe. In the first instance, it was stated that the directors were the largest sellers of the stock. This brought about an outright and emphatic denial from these directors. They said they haven't sold a share. In fact, they claim to have added to their holdings. The break was attributed by them to the manipulations of a large and well-handled bear pool, and the rise from the bottom has resulted from the buying by the insiders. Boston also has been acting on the belief that there is good news to come out on the stock, and advices from the Hub are to the effect that large blocks have been transferred from weak holders into the hands of capitalists around bottom figures. One of the bear rumors upon which the bear traders tried to influence the price of General Electric had to do with the coming dividend. This, it was reported, was to be passed. Of course, this was foolish on the face of it, and insiders hardly took the trouble to contradict it. The Drexel-Morgan people, however, assured their friends that the General Electric Company had sufficient cash in hand to make a regular dividend on the stock at the proper time. Not only did it have the money to do this, but the company has contracts on hand sufficiently extensive, it is said, to keep it busy for the next two years. The dividend of 3½ per cent. on the preferred stock, payable July 1, has been declared.

Detroit Electrical Works.—Further details are brought to light concerning the reorganization of this company. The committee having the reorganization in charge has determined to turn over the present company to a New York syndicate which is to furnish $200,000 fresh working capital. An issue of $1,000,000 common stock, $700,000 of preferred stock and $300,000 of five year bonds is to be made. The bonds, together with notes of an equal amount, are to be given to creditors, the bonds serving as collateral for the notes. For every two shares of the old stock one share of new stock is to be given. President Hugh MacMillan, who holds a mortgage on the property for $185,000, and could, were he so disposed, have forced a settlement without regard to reorganization, will stand by the property and comes in just the same as any other stockholder. It is reported that a majority of the creditors have already assented to the plan.

The Westinghouse people report that their net earnings are getting larger every week. The Westinghouse company during the week took its first order from the Brooklyn City Railroad Company for apparatus. The Brooklyn City has hitherto been using the apparatus manufactured by the Thomson-Houston company.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	25	30
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " " com	15	15	17½
Edison Electric Ill., New York	100	105	106
" " " lsts	...	109	110
*Edison Electric Ill., Brooklyn	100	98	103
" " " Boston	100	115	130
" " " Chicago	100	220	230
" " " Philadelphia	100	120	140
Edison Electric Light of Europe	..	2	6
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	12½	12¾
General Electric Company	100	73⅞	74
" " deb. 5's	..	84½	85
Interior Conduit and Ins. Co	100	30	40
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	24	25
" " pfd	50	45	47

* Ex. div.

AFFAIRS OF THE COMPANIES.

The Municipal Electric Light and Power Company, of St. Louis, has, it is reported, absorbed the Missouri Electric Light and Power Company.

The General Electric Company, of Cleveland, O., will invest $500,000 in improvements, $100,000 of which will be for a conduit system.

The General Electric Company has declared a dividend of 3½ per cent. on its preferred stock. The transfer books for preferred stock will be closed June 19 and reopened July 3.

R. E. Rust, receiver of the National Electric Manufacturing Company, of Eau Claire, Wis., has issued a notice that no change in the character of the machinery will be made, and the business will be continued in all the departments as heretofore, in the same manner as if no receiver had been appointed.

At the annual meeting of the Cataract Construction Company the following directors were chosen: Edward D. Adams, George S. Bowdoin, Charles F. Clark, Charles Lanier, Joseph Larocque, D. O. Mills, Wm. B. Rankine, Francis Lynde Stetson, Frederick W. Whitridge and Edward A. Wickes, of New York City, and Charles A. Sweet, of Buffalo. The present officers of the company are Edward D. Adams, president; Francis Lynde Stetson, first vice-president; Edward A. Wickes, second vice-president; William B. Rankine, secretary and treasurer. A meeting of the newly elected directors will be held soon to select officers for the coming year. It is probable that the present officers will be re-elected.

NEW INCORPORATIONS.

The Palouse Electric Company, Palouse, Wash., capital stock $30,000, has been formed to engage in electric lighting. W. T. McCaskey, H. W. Bassett, B. J. Mahlum, Z. Mitchell and A. P. Fuller, are the promoters.

The Tekoa Electric Company, Spokane, Wash., capital stock $20,000, has been formed to erect telegraph and telephone lines, electric light plants, etc. W. T. McCaskey, B. E. Barinds and A. P. Fuller, are the promoters.

The Lawrence Electric Company, New York City, capital stock $5,000,000, maximum, has been incorporated to furnish electricity, etc. G. E. Hicks, Benj. F. Hicks, Great Neck, and D. C. Fisk, Brooklyn, N. Y., are the interested parties.

The Pittsburgh, Greensburg & Latrobe Electric Railroad Company, Tyrone, Pa., capital stock $1,000,000, has been formed to construct and operate an electric railway in Westmoreland and Allegheny counties. J. L. Mitchell, J. H. Thompson, and G. L. Owens are the promoters.

The United Electric Light and Power Company, Bayonne, N. J., capital stock $50,000, has been organized to erect and maintain electric light plants, etc. M. R. Cook, C. E. Annett, G. H. Van Buskirk, E. F. White, C. S. Noe, Bayonne, and C. W. Parker, Newark, N. J., are the promoters.

The American Fuel Economizer and Engineering Company, Jersey City, N. J., capital stock $30,000, has been formed to manufacture and sell electrical appliances, etc. G. H. Burpee, Greenville; J. T. Underhill, East Orange, N. J., and J. H. Lyles, Brooklyn, N. Y., are the promoters.

The Donahoo Steel and Smelting Company, San Francisco, Cal., capital stock $500,000, has been formed to deal in electricity, iron, coal, etc. P. B. Donahoo, Wm. R. Thomas, Oakland; E. P. Gray, San Francisco, Cal.; H. A. Jones, Brooklyn, and J. S. Andrews, New York, N. Y., are interested.

The Youngstown & Canfield Electric Railway, Light and Power Company, Youngstown, O., capital stock $65,000, has been organized to construct and operate an electric railway. J. W. Canfield, S. O. Ewing, John Delfs, A. Dickson, A. Calvin, H. M. Osborn and John Sanzenbacher, are the promoters.

The Beck-Watts Fixture Company, Des Moines, Ia., capital stock $25,000, has been formed to manufacture and deal in electric and other fixtures. Wm. Watts, F. J. Watts, W. H. Beck, H. E. Coen, all of Chicago, and C. E. Hunn, E. S. Hunn and D. W. Evans, all of Des Moines, Ia., are the promoters.

The Beverly & Edgewater Park Electric Light and Power Company, Beverly, N. J., capital stock $30,000, has been formed to erect and maintain electric plants, etc. L. R. Hibbard, J. V. Rice, Jr., Edgewater Park; E. G. Harrison, G. M. Lane, and W. E. Harrison, Asbury Park, N. J., are the promoters.

The Western Electric Power and Light Company, of Topeka, Kan., and El Reno, Okla., capital stock $50,000, has been formed to build and operate electric plants. A. F. Chesney, E. E. Chesney, Jos. Reed, O. M. Chesney and Wm. Dignon, of Topeka, and Chas. Stackhouse, Osage City, Kan., are the promoters.

The Electric Developing and Supply Company, St. Paul, Minn., capital stock $100,000, has been incorporated to manufacture and sell dynamos, motors, electrical machinery and electrical supplies of all kinds. J. F. Hugher, N. L. Hills, St. Paul, Minn., and Lew Wentworth, Dubuque, Ia., are the promoters.

The Bellaire, Bridgeport & Martin's Ferry Street Railway Company, Bridgeport, O., capital stock $250,000, has been formed to construct and maintain an electric street railway from Bellaire to Martin's Ferry. J. K. Jolly, A. R. Leyda, R. J. Alexander, R. T. Howell and E. J. A. Drennan, are interested.

The Cooperstown Gas and Electric Company, Cooperstown, N. Y., capital stock $25,000, to manufacture and use electricity and gas, has been formed by the consolidation of the Cooperstown Gas Company and the Cooperstown Electric Company. The interested parties are: C. B. Staats, Albany; L. B. Crittenden and O. R. Butler, of Cooperstown, N. Y.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, June 12, 1893.

Mr. L. S. Dumoulin, electrical engineer, of Boston, passed several days in the city this week.

Mr. H. E. Webb, of the Solar Carbon and Manufacturing Company, Pittsburgh, was in the city this week.

Mr. J. S. Speek, of the Partridge Carbon Company, Sandusky, O., was in New York this week calling on the trade.

Mr. Thos. G. Grier, of Chicago, the well known supply dealer and representative of the Bryant Electric Company, was in the city this week.

The Board of Electrical Control reported to the Mayor recently that it has removed 143,175 feet of overhead wires in the past two weeks without expense to the city.

The Direct United States Cable Company has opened an important branch station for the accommodation and convenience of cablers in London at 50 Old Broad street, Winchester House, directly connected with the cables of the company.

Mr. P. C. Ackerman, manager of the New York office of the American Electrical Works, returned to the city Friday of this week from a month's trip on the road, during which he took in Pittsburgh, Cincinnati and Chicago. Mr. Ackerman is very enthusiastic regarding his stay of nine days in the World's Fair city and is most expressive in his denial regarding any extortion in Chicago.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., June 10, 1893.

The Whitney Instrument Company reports a very satisfactory business in its line of ammeters and voltmeters. These instruments are highly spoken of by users generally.

The Brown Electric Company, Boston, Mass., have contracts on hand to build and equip three electric street railroads. Its supply business has been all it could expect for this season, considering the general dull market.

The W. S. Hill Electric Company, Boston, Mass., has brought out its latest designs in fan motors. These are of perfect workmanship, and very attractive in appearance. Now that the warm season has set in a lively trade in this line is expected.

The Samson battery is so well known throughout New England that it will not surprise any one to know that the sale in the last two months by the manufacturers has far exceeded anything in its history and at such a time simply goes to prove the popularity of the Samson.

The Pettingell-Andrews Company has just published its catalogue, which will be found to be a very handy book, and should be in the hands of those dealing in electric light, railroad or supply material. In requesting a copy of this work it would be well to name Catalogue E. W.

The American Electric Heating Company, of 629 Atlantic avenue, Boston, recently gave a dinner to the representatives of the electrical press at which all the food served was cooked by electric heat. The verdict was unanimous in favor of the new method of cooking, and Mr. Jewell, who presided, and Mr. Parsons were pronounced the merriest of hosts.

The "Novak" incandescent lamp, which has recently been put on the market by Messrs. Claflin & Kimball Company, Boston, Mass., has proved a great favorite, if sales are any indication. The favorable reputation which the old Perkins lamp enjoyed has no doubt very materially aided the successful introduction of this, the latest improvement in incandescent lamps.

Another improved type of an incandescent electric lamp will be placed on the market this coming week. This comes from such a source that the electric public will at once welcome its appearance, as they know that this company's lamp was one of the leaders and had won an enviable reputation for efficiency. This was simply the outcome of the careful and attentive, and we might almost say the jealous, care which these people took to give to their patrons the very best that could be produced, and there is every reason to believe that the new lamp will prove to be all that they claim for it.

The American Heating Corporation, of Boston, is represented in New York by the Central Electric Heating Company, at 26 Cortlandt street, and in Boston by the New England Electric Heating Company, at 629 Atlantic avenue. The capital of the company is $5,000,000, and the following are the officers and directors: President, Edward Jewell; treasurer, Arthur B. Smith; directors, A. M. Dodge, New York, N. Y.; H. C. Duell, Syracuse, N. Y.; Ambrose Eastman, Boston; Frederick D. Hagar, St. Paul; Edward Jewell, Boston, Mass.; A. B. Smith, Cliftondale, Mass.; Charles Odell, Salem, Mass; J. F. Tams, New York, N. Y.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 MONADNOCK BUILDING, CHICAGO, June 10, 1893.

E. Wilbur Rice, technical director of the General Electric Company, was among the distinguished visitors of the week.

Prof. Elihu Thomson and family have been enjoying the Exposition. Like every one else, the professor is enthusiastic over the marvels of the White City, especially the electrical display.

Markle & Harnish, the well known Cincinnati representatives of the Siemens-Halske Electric Company, are in town, and report business remarkably good, considering the financial condition of the country.

The Central Electric Company is furnishing the Sentinel Building, of Milwaukee, complete with conduit and fittings made by the Interior Conduit and Insulation Company, for which it is the Western agent.

The Detroit Dynamo Company, Detroit, has sold for the Cudahy yacht, of Chicago, a 50-light direct dynamo, and for the St. Claire Hotel, of Detroit, all the tubing and several motors for ventilating, including one of 3 h. p.

S. M. Hamill, general manager of the Brush and Short companies, Cleveland, O., spent a few days in town last week. He was seen around the exhibits of his companies a great deal and feels justly proud of the magnificent display.

The Detroit Electric Company has been started by Joseph Abrahamson, formerly partner in the Detroit Wiring and Repairing Company. The office is located at 66 Griswold street, Detroit, and the firm will do wiring and construction work.

S. W. Travers, Southern agent of the Brush Electric Company, stationed at Atlanta, Ga., was one of the many people who thoroughly inspected the exhibit of that company last week. Mr. Travers also took in the other wonders of the fair.

The Chicago Insulated Wire Company, whose offices have up to date been located in the Northern Building, Chicago, have decided to move them to Sycamore, Ill., where the factory is. The business of this company has been steadily on the increase.

The Electric Scenic Theatre, one of the attractions on the Midway Plaisance, constructed and equipped by the Siemens-Halske Company of Berlin, was opened to the public last Friday. Some very interesting and artistic effects were produced by the electric lights.

Mr. Montgomery Waddell, of the firm of Waddell-Entz & Co., is spending a few days at the fair enjoying the sights. He is also paying considerable attention to his newly opened Western branch, now in charge of J. Holt Gates, as already reported in these columns.

F. C. Armstrong, Western agent of the Canadian General Electric Company, Ltd., and W. Rutherford, chief engineer of the same company, were in Detroit recently, having just finished installing a 1,000-light T.-H. machine for the People's Electric Company, of Windsor, Ont.

J. Fred. Schaefer, superintendent of the Illinois Electric Lamp Company, Chicago, has been placed under arrest, but released on bail, charged with taking lamps out of the factory and selling them for his own benefit while the factory was under injunction by the United States Court.

The Electric Heat Alarm Company, of Boston, has an interesting display fortunately located on "Newspaper Row," Electricity Building, and it is attracting a great deal of attention. Mr. E. Nashold is kept busy explaining its operation to the inquiring thousands who pass his corner every week.

Capt. W. L. Candee, of the Okonite Company, Limited, is spending a few days in the city looking after his exhibit at the World's Fair. The Okonite factory has been very busy and has been delayed in this particular line, but the work is now well under way, and promises to make a very creditable showing.

E. P. Roberts & Co., of Cleveland, O., electrical and mechanical engineers, will soon open a branch office in Detroit. Prof. Roberts of this firm was recently in Detroit in connection with several important contracts they have in charge there. The same firm contemplates locating a branch at Columbus, O.

H. Amundson, one of the directors of the K. A. P. Electrical Novelty Company, with offices at La Crosse, Wis., and 440 Monadnock Block, Chicago, who has a very artistic display at the World's Fair, was in Chicago for a few days last week looking after the interests of his company. He has returned to La Crosse.

The National Storage Battery Company, Limited, Detroit, Mich., has located its factory at the corner of Fifth street and Congress street, west, where it will have the necessary improved machinery for manufacturing. It proposes to sell local and State rights to manufacture its storage batteries, and claims that the validity of the patents has been favorably passed upon by competent authorities. It has now orders for lighting plants for three steamers and to propel one yacht. Its office is at 626 Hammond Building, Detroit, Mich.

OREGON CITY, Ore., June 5, 1893.

Tillamook, Ore., has telegraphic communication once more with Forest Grove, the line having been rebuilt.

Construction work has been commenced upon the telephone line from Pendleton to Canyon City, Ore., the distance being about 150 miles. The line will soon be in operation as far as Pilot Rock.

The City & Suburban Railway Company, of Portland, Ore., has been sued for $10,000 damages by W. G. Hedin, guardian of Dorcas Hedin, aged three years, who was run down and injured a few weeks ago, necessitating the amputation of three fingers of the child's hand.

The projected belt line electric railway from the central portion of Portland, Ore., which is to traverse University Park on the east side of the Willamette River, is making good progress. Nearly all of the property owners along the proposed route have granted the right of way and all suosidies asked for.

The Walla Walla Gas, Electric Light and Power Company has accepted its recently completed electric station for power transmission situated on Mill Creek, four miles from Walla Walla, Wash. The current is transmitted to the company's central station in the city, where it is used to operate a 2,500-light Edison incandescent dynamo and two arc machines. The power-house has an additional capacity sufficient for the operation of a projected electric railway system.

CANADIAN NOTES.

OTTAWA, June 10, 1893.

Bear River, N. S., is to have the electric light. The motive power will be supplied by the falls on the west branch of the river. The stock is being readily taken up. It is said that the plant used will be of the Thomson-Houston system.

Galt, Ont.—The Galt & Preston Street Railway Company is engaged making the necessary arrangements to commence the construction of its line at the earliest possible moment. If no unforeseen accident arises the railway will be in operation early this summer.

Renfrew, Ont.—A. A. Wright & Co. have made their purchase of plant for the incandescent electric lighting system they are about to introduce. They have selected the Thomson-Houston system, and the machinery will be imported from the United States.

Vancouver, B. C.—Application has been made in the Supreme Court for the appointment of a liquidator for the Vancouver Street Railway and Electric Light Company. The company recently built several lines to the outskirts of the city, which were run at a loss, causing financial difficulties.

Victoria, B. C.—The committee of the City Council, to whom was referred the matter of the purchase of the Electric Tramway and Light Company, have reported that, assisted by experts, they have arrived at the conclusion that the value of all the company's property—plant, contracts, franchise and everything—is $576,686. The company's estimate was $660,000.

Niagara Falls, Ont.—The Niagara Falls Park & River Company has tested the running of its cars by electricity and the trial was a great success. The private directors' and general manager's car was brought out and ran up to the Falls and down to Queenston, and glided over the splendidly ballasted road as if on an asphalt pavement.

Montreal.—For the first time the city will now be able to calculate as to the amount of money their contract with the Montreal City Passenger Railway Company will bring to the civic treasury. It will be remembered that a certain percentage of earnings was to fall to the city, and the chairman of the Finance Committee states that the amount received from the street railway up to date has amounted to $13,485.

Montreal.—Mayor Belanger and Councillor Daze, of St. Louis de Mile End, who were arrested at the instance of the Montreal Street Railway Company in connection with the removal of the rails laid down by that company on Park avenue, within that municipality, without the authorization of the Municipal Council, and who were acquitted by Judge Desnoyers, have instructed their attorneys to take out actions for $10,000 each for damages for false arrest against the street railway company.

Halifax, N. S.—Sealed proposals will be received by the Board of Commissioners of City Works until June 26, for lighting the streets of the city of Halifax for three years with arc lights, according to the terms and conditions in the form of contract, copies of which will be supplied. No tender will be considered unless accompanied by cash draft or a certified check for 10 per cent of the amount of contract for one year, payable to the city treasurer, to be forfeited to the city of Halifax if the successful bidder fail to execute the contract with satisfactory security within 10 days after notification of award of said contract.

Charles B. Hunt has been appointed local manager of the Canadian General Electric Company. The plant will be located on the river bank between the Grand Trunk Railway track and York street. The plans, which are prepared by their own architects, are for a substantial brick building 171 × 52 feet, with six engines of about 1,100 h. p. in the aggregate. The arc lighting plant will be placed in the south end of the building, with two engines of 200 h. p. each to drive the dynamos. This part of the building will be two stories, with the repair shops upstairs. In the centre of the ground floor will be the incandescent lighting and power plant, driven by 700 h. p. engines.

Hamilton, Ont.—Count von Siemens, the millionaire Prussian electrician, who is one of the backers of the great project to harness Niagara Falls for electric power purposes, will be at the Falls in a few days, and has summoned Projector John Patterson to meet him there and conclude the arrangements for commencing work on the Hamilton electric radial railway. It is expected that the construction of the line to convey the power to Hamilton will be commenced in less than two weeks. Electric power equivalent to 20,000 h. p. will be conveyed over this line. This will be sufficient to operate the radial railway trains, light the country electrically between here and the Falls, and allow surplus enough to run all the machinery in Hamilton, where the total amount of horse power now employed is about 8,000.

News of the Week.

THE TELEGRAPH.

Chinese Telegraphs.—The Chinese land telegraph line has been joined to the Russian system. Messages can now be sent to any part of the world from any telegraph station in China. Since this connection was made the cable companies have added 15 per cent. to their charges, but messages may be sent over the Chinese lines at the former rate—$2 per word—the cost of transmission across the Atlantic being added. The Chinese system now reaches Helampo, in the north, where the connection is made with the Russian lines; Aichow, in Hainan, in the south; Wenchuen, in Kirin, in the northeast; Takao, in Formosa, in the southeast; Suchan, in Kansu, in the northwest; and Zengyueh, close to the Burmah frontier, in the southwest. The only province which is not reached by telegraph is Hunan, which still remains opposed to all foreign innovations. There are 4 stations in Anhui, 8 in Chekiang, 11 in Chihli, 4 in Korea, 9 in Fukien, 10 in Formosa, 3 in Heilungchiang, 1 in Honan, 7 in Hupeh, 6 in Kansu, 4 in Kiangsi, 4 in Kiren, 9 in Kuangsi, 34 in Kuangtung, 2 in Kuischow, 3 in Shansi, 14 in Shantung, 2 in Shensi, 6 in Shingking, 6 in Szechuan and 10 in Yunnan, or 167 in all. The service is rapid and satisfactory. Parties sending messages have the right to designate whether they shall go over the cable lines or the land lines.

THE ELECTRIC LIGHT.

Branchville, N. J., is to have electric lights.

Waco, Tex., is to extend its electric light plant.

New Castle, Colo., is to have the electric light.

McDonald, Pa., is to have an electric light plant.

Branchville, N. J., is to have an electric lighting plant.

Waseca, Minn., will vote on issue of water and light bonds.

Oelwein, Ia.—Council is discussing the matter of electric lighting.

Chamberlain, S. D., is about to commence work on an electric light plant.

Quincy, Ill.—A movement is on foot to start a new electric light and power company.

Westwood, O., is to vote on the question of issuing bonds for $25,000 for an electric light plant.

Cooperstown, N. Y., has voted in favor of an appropriation for increased electric street lighting.

Allegheny City, Pa., will issue $100,000 in bonds to pay for an extension of the electric lighting plant.

Flushing, N. Y.—Contract for street lighting here has been awarded to the Flushing Gas Light Co.

Springfield, O.—P. P. Mast and Chas. Bauer are considering the question of an electric plant for their respective works.

St. Johnsbury, Vt.—The St. Johnsbury Electric Company has decided to put in a steam plant with which to run its dynamos.

Charleroi, Pa., will vote within the next 30 days in the matter of a bond issue which will include $2,500 for an electric lighting plant.

Brooklyn, N. Y.—The Edison Company has taken out a building permit for a brick building to be occupied as a central station at 366 Pearl street.

Dexterville, N. Y.—The Consumers' Arc Light and Power Co. has been formed to utilize the water power here. Charles H. Jones and O. E. Jones will give details.

Middletown, Pa.—An ordinance has been passed providing for a special election on June 27 to vote on proposed bond issue of $28,000 for an electric light plant. John F. Fritz is Clerk of the Council.

Oak Park, Ill.—At a meeting of the Cicero Town Board the recommendation of the local trustees of the Oak Park & Ridgland company was adopted for the placing of 95 additional electric lights as per schedule.

Oconto, Wis.—The Citizens' Light and Fuel Company is extending its building, and when completed a general overhauling of the machinery will take place. The power of the plant will be increased.

Ridgely, Ill.—The citizens of Ridgely will hold a mass meeting to consider the question of having the village lighted with electricity. The A. L. Ides Manufacturing Company, of Springfield, and the rolling mill company will make propositions, the latter being about to put in a plant to light the mills.

Conshohocken, Pa.—The Police, Fire and Water Committee of the Conshohocken Town Council will receive bids for lighting the streets of the borough by either arc or incandescent electric lights, or both, for one, three or five years. Bids will be opened Saturday evening, July 1. B. F. Baldwin is chairman of the committee.

Belle Plaine, Ia.—The City Council will receive sealed proposals until June 26 from parties who may wish to establish electric light plants in said city, for the purpose of furnishing lights for the city and for its citizens; said plant to have a capacity of at least 20 arc lamps of 2,000 c. p. each, from a regular arc dynamo generating electric current of 1,250 volts, and also for 700 16-c. p. incandescent lamps; must give a full schedule of prices for all-night arc street lighting, capacity as above stated, commercial arc and incandescent and residence lighting; said plant to be in operation by Oct. 1, 1893. Propositions must be accompanied by approved bonds of $2,000. Fred W. Brown is city clerk.

THE ELECTRIC RAILWAY.

The Tiffin & Fostoria road has been commenced.

Cedarville, N. J., is to have an electric road to Fairton.

Girard, O., is discussing an electric road to the Mahoning County line.

Clarksville and Ashton, Md., are to be connected by an electric road.

The Bridgeport (Conn.) Horse Railroad Company is to adopt electric power.

The Gettysburg (Pa.) trolley road has changed its route in deference to public opinion.

Zanesville, O.—The street car line will be extended on Forest avenue to Maplewood Park.

Piedmont, Cal., East Oakland and the Emeryville Ferry are to be connected by an electric road.

Waco, Tex.—The Waco Electric Railway Company will extend the system a distance of two miles.

Mt. Tom, Mass., is to have a branch from the Holyoke electric road run to the summit, it is reported.

Bellows Falls, Vt., is discussing an electric road to Saxton River; $24,000 of $50,000 has been subscribed.

Jamestown, N. Y.—The Jamestown Street Railway will build an electric road to Celeron, work to begin at once.

West Buxton, Me.—Residents are moving in the matter of the proposed electric road from here to Bonny Eagle.

Aluminium tickets the size of a silver 25-cent piece will be used by the new Kalamazoo (Mich.) electric street railway company.

The Sandusky (O.), Milan & Huron Electric Railway is now being graded and it is proposed to have it in operation by July 1.

Lake George, N. Y.—It is proposed to connect Lake George to Troy, using the roads of Mr. J. A. Powers at Stillwater and Glens Falls as connecting links.

The Electric Railway Company of Savannah, Ga., of which Mr. J. W. McFarland is superintendent, is in need of supplies for an electric light plant.

The Cayadutta (N. Y.) Electric Railroad Company is reported to be negotiating for the steam roads from Johnstown, the F., J. & G. and the J., G. & K. roads.

The Montreal Street Railway Company is equipping its new power house with Westinghouse multipolar generators, supplied by the Canadian agents, Ahearn & Soper, Ottawa.

Asheville, N. C.—The Asheville Loan and Improvement Company has purchased the Montford Avenue Railroad line. The new company will extend the line to the French Broad River.

Stevens Point, Wis.—The franchise for an electric street railway granted to George A. Whiting has been extended for a year, and work will begin as soon as the bonds can be placed.

Warren, O.—John E. McVay, of Youngstown, O., is looking into the matter of his proposed $50,000 electric road between Warren and Youngstown, and between Youngstown and Girard.

Scranton, Pa.—An ordinance is before Select Council authorizing the Rapid Transit Company to build a street railway from the corner of Lackawanna avenue and Franklin avenue to the city line.

The Pennsylvania Traction Company's trolley bills and the bill in favor of the so-called Philadelphia electric light combine were defeated at the closing session of the Pennsylvania Legislature.

New Philadelphia, O.—The only bid for the electric street railway franchise between New Philadelphia and Uhrichsville was from E. C. Michiner. The franchise will be granted to him at the next meeting.

Trenton, N. J.—The Electric Commission here has granted permission for the erection of a trolley system by the Suburban Traction Company, of Orange, N. J., and by the Rahway Electric Company, of Rahway, N. J.

New Orleans, La.—The St. Charles Street Railway Company has had an engineer looking over the ground, and he estimates that it will cost between $200,000 and $300,000 to convert it into an electric system. Mr. McLean is president.

The Marion Street Railway Company, of Marion, Ind., has commenced work on a line of road to Gas City, via the Soldiers' Home. The Ansonia Electric Company's new line of overhead railway fixtures will be used on the entire road.

Nutley, N. J.—The electric railway and electric light questions are still agitating the residents, and the town committee is undecided about granting a franchise, and no definite action will be taken until after the public meeting, which will be held June 19.

The Fort Clark Electric street car line at Peoria, Ill., seven miles long, has passed into the hands of the General Electric Company of Chicago, because it was unable to pay the interest on the amount advanced by the latter company for its equipment.

Little Rock, Ark.—The Fort Smith & Van Buren Electric Street Railway, Light and Power Company, capital $100,000, proposes to change the street railway in Fort Smith into an electric line and to build the line to Van Buren, a distance of five miles.

Chicago, Ill.—A syndicate of Chicago capitalists headed by Stephen A. Douglas, Jr., is looking over the ground between St. Joseph and Niles with the intention of building an electric railway with a possible southern terminus at some point in Indiana.

Burlington, Vt.—J. A. Powers, vice-president of the Winooski & Burlington Street Railway Company, is now getting figures on equipment for the road. It is proposed to break ground within three weeks. This will be the first electric railway in Vermont.

Glens Falls, N. Y.—The Glens Falls, Sandy Hill & Fort Edward Street Railway Company contemplates building a branch to the cemetery in South Glens Falls, and Frank O. Sinclair, of Burlington, Vt., is now making a survey. The company proposes to increase the present motive power by addition of a dynamo and engine of 250 h. p.

A Big Profit.—It is reported on good authority that the Fonda, Johnstown & Gloversville Railroad, which recently was bought by H. Walter Webb, has been absorbed by the Cayadutta Electric Railroad Company, a rival line. By the deal Mr. Webb, it is said, has made $170,000 in a few months, while William Littaner, of New York, makes $100,000.

Montgomery, Ala.—The Cloverdale electric line and property will be sold at auction. The sale of this property means that Montgomery will have a first class system of rapid transit if there be nothing to prevent the consolidation of the Cloverdale line and the Montgomery Terminal Street Railway, which is now pending. The system will probably be an organization with a capital of $350,000.

The Schuylkill Traction Company, Ashland, Pa., has increased its stock from $600,000 to $10,000,000, and the mortgaged indebtedness from $300,000 to $500,000. The increased funds are to be used solely for the betterment and extension of the system. The question of building the proposed branches from Giberton to Shenandoah and Ashland to Centralia were discussed. It will cost but $40,000 to build and equip the Centralia branch. The president, Mr. Bailey, is very much in favor of its construction.

Tennessee Electric Roads.—An application for a charter has been made by the Robertson Southern Electric Railway Company, with headquarters at Knoxville. The object of this company is to construct an electric railway from Knoxville to Kingston, Oliver Springs, Poplar Creek Coal Mines, Clinton, Andersonville, Powell's Valley, Luttrell, Maynardsville, Blaine's Cross Roads, Lee's Springs, Strawberry Plains, Dandridge, Sevierville, Allegheny Springs and the Little Tennessee River, in Monroe County, with stems from the main line to many points. The company expects to haul both passengers and freight, and in effect to eventually construct a cheap system of railways through all East Tennessee. Application has also been made for a charter for the Paint Rock & Tennessee River Railway Company to build an electric railway line from Winchester, Franklin county, to McMinnville, by way of Decherd, Viola and Beersheba Springs. The line is also to be extended to the head of Estill Fork Creek, of Paint Rock River, thence to Savannah, Mineral Springs, Lynchburg, Pulaski, Lawrenceburg and Waynesboro, in Wayne County.

LEGAL NOTES.

The Western Electric Company, of Chicago, has entered a protest against paying $10,750 of corporation tax levied by the State of New York for the years 1889, 1890 and 1891. The company claims to be exempt on the usual ground that it is a manufacturing corporation; also that it has been assessed partly on capital employed altogether outside of this State.

Lamp Suit.—The Edison Electric Light Company and the Edison Electric Illuminating Company instituted equity suits on June 5 in the United States Circuit Court, one of them being against William Zimsser, the owner of the building No. 15 Spruce street; another against Robert Goelet, Ogden Goelet, Robert Staf-

ford and Henry P. Whittaker, owners and managers of the hotel at Thirty-second street and Broadway, and a third against Mary J. Van Doren, Holland House Company, Herbert M. Kinsley and Gustave Baumann, of the Holland House. The plaintiffs in all the suits seek to restrain the use of the incandescent lamps belonging to other systems than the Edison, and ask for an accounting of the gains made in consequence of the use of the incandescent lamps, and payment of damages for any loss which the Edison company may have suffered from the competition.

PERSONAL NOTES.

Lieut. John E. Roller, U. S. N., has been ordered in charge of the electrical department of the New York Navy Yard.

Mr. Hermann S. Hering, who was offered the Directorship of the Department of Electrical Engineering at Purdue University, as mentioned in the last issue of THE ELECTRICAL WORLD, has decided not to accept that position.

Mr. Karl Koch, the well known wire manufacturer of Hohemlimburg, Germany, is on a visit to the United States, principally for the purpose of seeing the World's Fair. Mr. Koch's address will be, care of Mr. E. Koch, 3726 Evans avenue, St. Louis, Mo.

Mr. C. E. L. Brown, the well known European engineer and electrician, so long identified with the Oerlikon works, in Switzerland, returned to Europe on the Bourgogne from a visit to the World's Fair. Mr. Brown, at his new works in Baden, is carrying out a large number of orders for transmission work, of which there are sufficient on hand at present to keep the works in full operation for a year.

Mr. Henry G. Issertel, the popular and genial representative of the A. B. C. Company, was married on Tuesday, June 6, to Miss Idabel Blakeman, at the bride's residence, 191 Livingston street, Brooklyn. The room in which the ceremony was performed was handsomely decorated with artistic designs and set pieces formed of incandescent lamps, and the many friends present of the happy couple were profuse in their expressions of admiration at the beautiful effect produced.

Mr. Geo. Cawley, chief editor of *Industries*, London, Eng., is about to retire from the position which he has held since our contemporary started, some seven years ago. At that time it was thought by many that the needs of technical readers were generally well met by older journals; but in spite of this view, and of the usual difficulties connected with the early life of nearly all journalistic ventures, Mr. Cawley has succeeded in piloting *Industries* to an established position in the field of technical journalism. At the beginning of this year a change occurred in the proprietary of our contemporary, and this, we understand, led to Mr. Cawley tendering his resignation. After concluding his editorial work he intends carrying on business as consulting engineer, and has taken offices at 29 Great George street, Westminster, S. W.

MISCELLANEOUS NOTES.

Fishing with Electricity.—Prof. Boschke, of Galveston has invented an electrical fishing apparatus. An electric light attracts the fish within the net, the opening of which is then closed by an electrical mechanism.

The Stanley Electric Manufacturing Company, of Pittsfield, Mass., lost one of its buildings recently through fire. The building was a small one used for their distinctive processes of insulating transformer coils and condensers.

Baltimore, Md.—Sealed proposals will be received to 3 P. M., June 20, for furnishing the cables, trenching and laying new conduits for the underground wires of the police and fire alarm telegraph system, as per details to be had of J. Alex. Preston, president of the Board of Fire Commissioners.

Requisitions will be issued, it is reported, by Governor Pattison, of Pennsylvania, for the apprehension of Messrs. Clark and Hamilton, two officers of the General Electric Company, recently indicted in Pittsburgh upon charges preferred by the Westinghouse Electric and Manufacturing Company.

Strike at Schenectady, N. Y.—The pattern makers in the works of the General Electric Company went on a strike on June 9 on account of a change requiring the men to begin work earlier in the morning and work a few minutes more each forenoon and afternoon in order to give them a half holiday on Saturday.

Municipal Ownership.—The Thiele bill now pending in the Illinois Legislature to enable municipalities to furnish light, heat and power has passed the Senate, but will probably fail in the house. Public sentiment is said to be in favor of it, but it is claimed that it is being tied up by interested parties.

Wiggins, the weather prophet, says that the telegraph wires cause droughts, and that this year America has all of the electrical energy and Europe none, which explains the droughts in Europe and the floods in America. He states that if all wires were buried, cyclones and droughts, with rare exceptions, will disappear from our continent.

Mr. W. H. Fitzgerald, manager of the Detroit Electric Light and Power Company, charged with an attempt to bribe an alderman, has been discharged by the police court justice, who declined to hold him for trial on the ground that the testimony was not sufficient to justify it. Mr. Fitzgerald will now proceed to bring action against the mayor and others implicated in causing his arrest and endeavor to secure damages.

The New Plant of the Westinghouse Company.—The plans of the new plant to be built at Brinton Station by the Westinghouse Electric Company have been made public by J. R. McGinley. The company owns 222 acres of ground, and at present 23 acres will be set apart for the electric works. The building will be constructed of stone, brick and steel and in a new method. It will be of the most substantial character and fireproof. The works in Allegheny City and Newark, N. J., will be consolidated and all carried on at Brinton. Mr. McGinley says the estimated saving in the combination and the handling of material will be $250,000 a year.

Electricity in the Household.—All of the cooking in the Minnesota Club house at St. Paul is done byfelectricity, and the members are enthusiastic over the superior manner in which electric heat does the work. The heat being distributed evenly in the various utensils, the cooking is evenly done and the flavors retained, while the inconvenience is reduced to a minimum. Mr. George Foster Peabody, of Brooklyn, has dispensed with coal entirely, and all household operations are now performed by electricity. The house is lighted by electricity, warmed by electric heaters, and cooled in summer by electric fans; the cooking is done and all water heated by electricity, and the ironing rendered easy by the use of electric irons. Whenever power is needed, electric motors are employed, as for running a sewing machine or in laundry operations.

The Westinghouse Charges.—The New York *Tribune* states that in Pittsburgh, on June 6, the Grand Jury returned true bills for conspiracy against the following officials of the General Electric Company: C. A. Coffin, of Boston, president; W. J. Clarke, of Lynn, Mass., manager of the railway department; Milton H. Hamilton, of New York; E W. Rice, of Lynn, and H. W. Knight, of Boston. All these gentlemen are officials of the General Electric Company. True bills were also found against Morris W. Mead, superintendent of the Bureau of Electricity, for conspiracy, and against C. Christian, John Butler and Frank Carey, former employés of the Westinghouse company, for conspiracy and larceny. It is alleged that the defendants conspired to secure blue prints and tracings showing the design and construction of certain machinery owned by the Westinghouse Electric Company.

Association of Electrical Dealers and Contractors.—The leading electrical firms of Washington, D. C., have recently formed an association for establishing a more general and better understanding and unanimity among themselves, and for their mutual benefit. The association was organized last July and is known as the "Association of Electrical Dealers and Contractors." The officers for the ensuing year are: President, C. W. Jordan; vice-president, J. W. Burkett; secretary, C. W. Messner; treasurer, John R Calloway. The firms represented are Messrs. Jordan & McLeod, J. W. Burkett & Co., Royce & Mareau, the Washington Construction Company (Pardoe & Messner), the Bliss Engineering Company (Bliss & Lewis), John R. Calloway, D. H. Washburn and J. H. Kueling. The association is in a flourishing condition and has already shown to its members that it is a valuable aid to electrical interests in Washington.

Trade and Industrial Notes.

The Ansonia Electric Company, of Chicago, has just closed a large contract for Shield brand wire in Iowa.

W. W. Tupper & Co., of 29 Cortlandt street, New York City, report increasing sales for their grate bars, which are claimed to have no superiors.

The Peckham Motor Truck and Wheel Company has removed to 1,006 Havemeyer Building, 26 Cortlandt street, New York City.

The Electrical Engineering and Supply Company, St. Paul, Minn., has been appointed Northwest agent for the high grade Packard lamps.

Mr. T. J. Murphy, 136 Liberty street, New York City, manufacturer of Italian and American marble and electric slate for switchboards, reports business exceedingly brisk.

The Guelph Gas Company, Guelph, Ont., has changed its corporate name to that of the Guelph Light and Power Company, under which its business will hereafter be transacted.

Mr. Geo. A. Hill, manager of the Typewriter Exchange, 10 Barclay street, New York City, says that notwithstanding the advent of the heated term, the sales at his Exchange have perceptibly increased.

Messrs. L. D. Hatton & Co., corner Greene and W. Fourth streets, New York City, importers and manufacturers of fancy and staple electric glass, are placing upon the market new and salable designs in glass for electric use.

The Electro-Chemical and Specialty Company, 1 6 Liberty street, New York, is receiving large orders for the Atlantic fan motor and the Atlantic primary battery, which are reported to give high satisfaction to the trade.

The Wagner Electric Manufacturing Company, of 2,017-2,023 Locust street, St. Louis, Mo., has issued two neat catalogues, one devoted to its line of direct current dynamos and motors and the other to direct and alternating current fan motors.

The Commercial Cable Company has issued a neat little fac-simile cablegram addressed to "Sightseer, Chicago," calling attention to the company's pavilion, section Y, floor two (gallery), Electricity Building where a model Atlantic cable is in operation.

Mr. E S. Boggs, general manager of the New York Electrical and Development Company, 251 William street, New York City, reports large orders for their new electric automatic lighter for gas or electricity. This lighter is meeting with flattering success among supply houses generally.

Mr. J. Gillet Noyes, general manager of the National Manufacturing Company, Milford, Conn., reports that he is running his works to their full capacity. This company has now entered upon the manufacture of electrical specialties, and from the present outlook its factory will soon be inadequate to fill the large orders.

W. H. Ostrander & Co., 204 Fulton street, New York City, have issued the ninth edition of their catalogue, in which is described and illustrated the various pieces of apparatus manufactured and handled by this company, including speaking tubes, and speaking tube hardware, annunciators and bells and electrical supplies.

The Berlin Iron Bridge Company, of East Berlin, Conn., will build a new machine shop for the Fuller Iron Works, at Providence, R. I. The peculiarity of this shop will be that the sides are entirely of glass, under the patents lately granted the Berlin company for this construction. The building will be 90 feet in width and 210 feet in length.

Mr. Charles Ludlow Livingston has opened an office in the Fidelity Building, Room 121, Fourth avenue, Pittsburgh, Pa., where he will carry on the business of contracting for the complete equipment of street railways, central stations, isolated plants, etc., and will give special attention to the wiring of fine residences, business blocks and churches.

The Wisconsin Electrical Construction Company, Milwaukee, Wis., manufacturers of the Milwaukee commutator brush, report large sales, and believe that they have solved the problem of a brush which will neither spark nor wear out. Several large dynamo manufacturers are now using them, and many testimonials are being received as to their merits.

The Central Electric Company, Chicago, is getting in large consignments of okonite, and is filling its orders promptly. The sales of okonite for the last month, it is claimed, have been enormous, and the factory has had more than it could do to keep up with the demand. By increasing its facilities, adding new machinery and working overtime the company have been able to get abreast of the demand.

Mr. C. M. Fitch, general manager of the Fitch Excelsior Switch Company, 15 Broadway, New York City, gave a trial of his improved automatic switch for electric railways on the Steinway electric road, Astoria, N. Y., on Thursday, June 8. The trial was very successful and was witnessed by a large party of experts and street railway men, who were afterward entertained by Mr. Fitch at a dinner at the Grand Union Hotel, New York.

The Detroit Electrical Wiring and Repair Company, Detroit, Mich., is doing an extensive business in wiring new buildings, which are now going up rapidly in that city. In addition to contracting for electrical apparatus for buildings and private residences, this company also handles dynamos, motors, burglar alarms and general electric supplies. Its new self-adjusting boring machine has met with great favor.

The Vilter Manufacturing Company, of Milwaukee, Wis., is building for the Minneapolis General Electric Company a 1,200 h. p. Corliss engine. It has also sold an 18 × 24 engine to Wm. Bayley & Sons, of Milwaukee, and another of 20 × 42 to Wm. J. Mayer, of Chicago, for use in running dynamos. The engine for Green Bay heretofore mentioned in THE ELECTRICAL WORLD is just now being installed at Green Bay.

The Standard Underground Cable Company, of Pittsburgh, has started work upon probably one of the largest contracts which has ever been given out, comprising the feeder wire for over 240 miles of street for the Philadelphia Traction Company, which covers the whole system. This is an important contract, has been placed in good hands, and the contractors are to be congratulated in having secured such an important contract.

Henry R. Worthington, 86-88 Liberty street and 145 Broadway, New York City, the well known manufacturer of the Worthington pumps, has published a very handy map of the Exposition grounds, showing in particular the location of the 22 exhibits of this firm. The company has also published a little pamphlet descriptive of the Worthington apparatus and containing a reduction of the larger map of the World's Fair grounds above referred to.

The Electrical Forging Company, 163-167 Oliver street, Boston, Mass., has issued a very handsome catalogue giving a number of views in its works at Boston as well as a large number of the products of its manufactures. This company controls the Burton method of producing electric heat under patents in this country and many foreign countries. It is capitalized at $2,000,000.

Mr. Frederic A. Duggan, of the Imperial Porcelain Works, Trenton, N. J., is having great success with his new horseshoe cut-out; he is also perfecting a new wire cleat which will admit of any size wire, and which will shortly be introduced to the public. The chief advantage of this cleat is that the top and bottom are interchangeable, that is, the top and bottom are the same, and no one piece would necessarily be thrown away in case the other be broken.

The Buckeye Electric Company, Cleveland, O., is having a steadily increasing demand for Buckeye lamps. One central station has used 15,000 during the past year, without the return of a single lamp for any cause. This is explained by the high average service rendered. Low operating cost, long average life and beautiful lighting effect are the three cardinal virtues that commend the Buckeye lamp to the electric lighting world.

Queen & Co., incorporated, Philadelphia, have a new specialty in the "Acme" portable testing set, described elsewhere in these columns, which can hardly fail to meet with great favor. It is remarkably compact and complete, all necessary parts, including battery, being contained in one small and handsomely finished mahogany case that weighs only six pounds. The set is particularly well adapted to outside testing, but gives equally accurate results in central stations or factories and on shipboard.

The Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., during May received orders for alternating generators capable of supplying 70,000 16-c. p. lamps, and about two-thirds of these orders came by mail unsolicited. The Missouri Electric Light and Power Company, of St. Louis, has adopted the World's Fair type of machine and ordered the first combined engine and generator of that type. The Louisville Electric Light Company has recently contracted for four large generators, the armatures 16 ft. in diameter, to be fitted to the shafts of Corliss engines.

The J. H. & D. Lake Company, manufacturers of all kinds of friction clutch pulleys, having outgrown its old quarters at Hornellsville, N. Y., has recently completed and removed to its handsome new offices and foundry at Massillon, Ohio, where with enlarged facilities it is prepared to meet the growing demand of its business. An interesting feature regarding the rapid growth of the Lake Company is the fact that it came almost exclusively from advertising, for with the exception of a limited amount of traveling, they have had no representative out on the road, only their card in the various class journals.

Free Wiring Specifications.—The *Architects' Electrical Bulletin*, published by the Interior Conduit and Insulation Company, announces in the latest issue that in order to assist architects, and secure uniformity in wiring as well as to place bidders on an equal footing, they have established a department for the express purpose of drawing up wiring specifications. If architects will send their plans to them with the location of the outlets and lights marked on the same, they will go over the plans, lay out the conduit system thereon, and draw a full specification for the wiring in question, giving, free of expense, the benefit of all improvements that are made from time to time, and that cannot be brought before the public at large for some months after adoption in New York and the larger cities.

The Central Electric Heating Company has been organized under the laws of the State of New Jersey and has purchased from the American Electric Heating Corporation all of their rights under their patents in the States of New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, Kentucky, Ohio, Michigan and the District of Columbia. They have offices at 617, 618, 619, 620 Havemeyer Building, 26-28 Cortlandt street, with laboratory and factory at Milford, Conn., where they are manufacturing electric heating appliances of many kinds for cars, household and industrial purposes. The officers of this company are, A. M. Dodge, president; J. F. Tams, vice-president; Bradish Johnson, treasurer; G. B. Hollister, secretary and assistant treasurer, and Edward B. Wyman, manager railway department.

The sales of the Stirling boiler during the present year are claimed by its representatives to show a heavy increase over the preceding year, and, among others, we are told that the following parties have closed with the company for plants during the last six weeks: Ætna Standard Steel and Iron Company, Bridgeport, O. (second order), 1,000 h. p.; Whitman & Barnes, Chicago, Ill. (second order), 1,000 h. p.; Cleveland Street Railway, Cleveland, O., 750 h. p.; Allentown Electric Street Railway, Allentown, Pa., 900 h. p.; La Fayette Street Railway, La Fayette, Ind. 250 h.p.; Leonce Soniat, Dorcyville, La., 250 h. p.; Ernst & Co., New Orleans, La., 200 h. p.; Planters Mill, New Orleans, La., 125 h. p.; Consolidated Kansas City Smelting and Refining Company, Argentine, Kan., 250 h. p.; The Hope Company, Hope, R. I., 100 h. p.; Lehigh Coal and Navigation Company, Lansford, Pa., 400 h. p.

Chas. Heinel & Co., Wilmington, Del., manufacturers of electric motors and commutators, who also make a specialty of repairing and reconstructing the latter, report that this business has grown to such an extent that the company is now overrun with orders from some of the leading firms in this country, including the General Electric Company, of New York, and Westinghouse Electrical and Manufacturing Company, of Pittsburgh, which is sufficient evidence to demonstrate the superior workmanship and quality of material used necessary for the reconstruction of old commutators. It is claimed that old commutators can be made as good as new by this firm. The small motors manufactured by this company are beautiful in design and high in efficiency, possessing the same quality of workmanship as that of the commutator.

J. H. Bunnell & Co., 76 Cortlandt street, New York City, have recently installed in Moore's Windsor Hotel, Filbert street, Philadelphia, an incandescent lighting plant that has created very

favorable comment through its excellent working. The plant consists of a C. & P. 500-light direct current dynamo, which is a new machine recently put on the market by this enterprising firm. There are 900 lamps in the hotel altogether; a Mexican onyx slate switchboard 5 × 6 feet contains the various controlling devices, etc., consisting of six knife and three dynamo switches, three voltmeters and three Queen ampère meters, two of which are for 250 ampères and the other for 300 ampères. The dynamo is connected to a Valley high-speed engine manufactured by Reilly & Sons, of Williamsport, Pa. The belting was furnished by J. E. Rhoades & Sons, Philadelphia. Two machines of the La Roche system, of Philadelphia, of 300 lights, each carry the load in the daytime, while the C. & P. dynamo does the work in the evening. Mr. J. H. Moore, the engineer and electrician of the hotel, has very much to say in favor of the C. & P. dynamo. The machine is manufactured by the Easton Electric Company, of Brooklyn, of which Mr. W. D. Perry is president; Mr. Alex. Churchward, electrician; and J. H. Bunnell & Co. are the sole selling agents. C. S. Clunn, 1,217 Filbert street, is the local agent for Philadelphia and vicinity.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company of 105 South Warren street, Syracuse N. Y.

Where to Locate New Factories.—The Illinois Central Railroad Company is desirous of calling the attention of capitalists and manufacturers to the advantages possessed by the different cities and towns on their Southern lines and on the lines of the Yazoo & Mississippi Valley Railroad Company in the shape of unlimited raw material proximity to markets, cheap labor, fuel, etc., and believes that it needs but a presentation of their merits to attract the careful attention of all interested in converting the raw materials to be found on their lines into the finished product. Prominent among these are cotton, hard and soft wood, clay, fruits, vegetables, etc. A descriptive pamphlet of 150 pages, entitled "Where to Locate New Factories," has been issued by the company, and a copy will be sent free on application to the undersigned, who will also give any further information as to inducements offered by the different localities for desired industries. Individuals or companies wishing to embark capital in cotton, clay, woodworking, canning or other industries can find a profitable field and hearty co-operation. For particulars address Geo. C. Power, Industrial Commissioner I. C. R. R., 58 Michigan Avenue, Chicago.

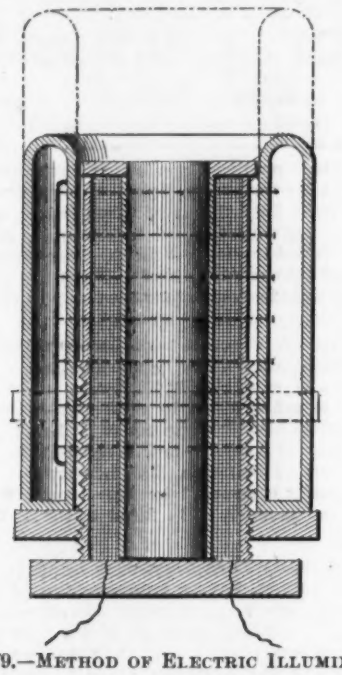
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED JUNE 6, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

498,757. Insulated Conductor; T. F. Attix, Brooklyn, N. Y. Application filed Dec., 1892. An insulated electric conductor of an inner tubular coating tightly braided about the exterior of the insulated conductor and treated with waterproof material, and a second tubular coating tightly braided about the exterior of the inner tubular coating and treated with fireproof material.

498,758. Lamp Socket and Key Holder Therefor; H. P. Ball and Amandus Metzger, Schenectady, N. Y. Application filed Aug 3, 1892. A switch spindle operating and holding device consisting of a sheet metal piece with a coiled end and cam edge.

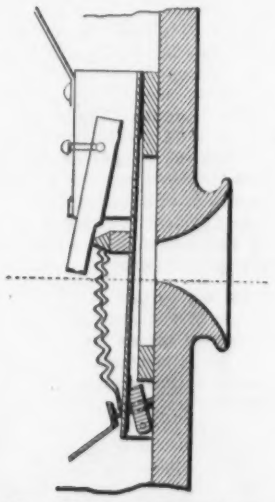


No. 498,879.—METHOD OF ELECTRIC ILLUMINATION.

498,763. Electromotive Device; Romaine Callender, Brantford, Canada. Application filed June 14, 1892. An electromotive device consisting of an electromagnetic coil having circuit connections on one side with a source of variable resistances connected in multiple arc relation therewith; with an armature or solenoid core connected through a circuit changing device, with the aforesaid resistances on the other side of the coil.

498,776. Clamp for Electric Conductors; Axel Helmer Englund, Chicago, Ill. Application filed June 29, 1891. The combination with jaws having male and female connecting devices adapted to be engaged by relative longitudinal movement of the jaws, and each provided with a semi-cylindrical externally threaded shank, of a threaded socket to receive the threaded shanks when in position.

498,799. Rheostat; E. R. Knowles, Middletown, Conn. Application filed Jan. 9, 1893. A rheostat comprising a plurality of slate cylinders, two rigid frames to which the cylinders are attached at their ends, helical coils of wire encircling these cylinders and connected in series, and one or more movable bridges to connect adjacent coils between their ends.



No. 499,108.—TELEPHONE.

498,808. Telephone Switchboard Annunciator; F. R. McBerty, Downer's Grove, Ill. Application filed Oct. 29, 1892. The combination, with the restoring magnet, of the night bell springs mounted thereon, adapted to be closed together by the armature, metallic terminal pieces mounted on the magnet, one of the metallic terminal pieces mounted on the magnet, and one being connected with one spring of the night bell spring.

498,852. Closed Conduits for Electric Railways; C. J. Kintner, New York. Application filed June 27, 1892. In an electric railway system a trolley shoe or bar supported in a slitted conduit, in combination with means for keeping that part of the shoe heated which is adjacent to the conducting portions of the slitted conduit.

498,864. Railway Signal; J. W. Steele, Chicago, Ill. Application filed Oct. 5, 1891. The combination with the bar having a double rachet thereon, of bars pivoted upon crossbars, pawls, means for actuating same, and means for obliquely tilting the crossbars upon which the bars are pivoted.

498,865. Railway Signal; J. B. Stewart, Haverstraw, and W. G. Wattson, Tappan, N. Y. Application filed May 3, 1892. In an automatic signaling system, the combination with two separate series of lamps corresponding to each section or block, of an electromagnetic controlling device connected to the rails of each block, the device being provided with an armature carrying double contacts controlling both series of lights in the preceding circuit, the armature also carrying a contact controlling a signal circuit connected to the signal station.

498,869. Telephone Handle or Holder; B. M. Wilkerson, New York. Application filed April 14, 1891. A handle for a telephone receiver consisting of a handpiece having its upper end bent, forming a short arm at substantially right angles to the main body thereof and attached to the receiver by a pivot passing through the end of the short arm.

498,871. Electrical Transmitter for Telemeter Systems; C. W. Ayton, New York. Application filed Feb. 10, 1892. The combination, of a ratchet wheel engaged with an armature of an electromagnet, of a spring acting in opposition to the action of the magnet and engaged with the wheel, a second magnet whose armature is provided with an arm extending to the rim of the wheel and having a notch in the end thereof, a pawl provided with a pin resting upon the end of the arm in the path of the notch and a second pin upon the wheel in the path of the arm.

498,872. Receiver of Telemeter Systems; C. W. Ayton, New York Application filed June 7, 1892. The combination with a feed roller carrying a web of paper, a guide rod, a spring pressing on the web which is between the rod and spring, a receiving roller having a slot containing one end of the web, and flanges upon the ends of the roller.

498,878. Electric Illuminating Apparatus; Edward A. Colby, Newark, N. J. Application filed Feb. 15, 1893. The combination of an electric glow lamp having a filament in ring or closed coil form, a coil and a source of varying electric current connected with it, the filament and coil being disposed in inductive proximity.

498,879. Method of Electric Illumination; Edward A. Colby, Newark, N. J. Application filed Feb. 15, 1893. A method of causing incandescence in an electric glow lamp, which consists in disposing the filament of the lamp as the secondary of an induction coil or transformer and causing a varying current to traverse the primary of the transformer. (See illustration.)

498,880. Electric Switch; James des Brisay, New York. Application filed Nov. 23, 1891. In a switch one or more contact springs attached to metal lugs imbedded in a non-conducting rotary part.

498,901. Incandescent Electric Lamp; Alex. de Lody guine, Paris, France. Application filed March 11, 1892. A seal for the leading-in wires of incandescent lamps, composed of glass or vitreous composition containing the compounds of boron.

498,906. Conduit Railway Trolley; M. H. Smith, Halifax, England. Application filed April 6, 1886. In an electric railway or tramway system the combination with a car carrying conductors, of a frame or trolley carrying conductors and collectors, the frame and conductors being detachably connected to the car by flexible releasing clips.

498,907. Electrical Condenser; Wm. Stanley, Jr., and Wm. B. Tobey, Pittsfield, Mass. Application filed Jan. 9, 1892. A condenser composed of sections separately encased in boxes of heat conducting material, contained in a main box or casing with air spaces between the main box being provided with openings for securing ventilation.

498,911. Copying Telegraphic Apparatus; S. P. Denison, Belleville, N. J. Application filed Feb. 1, 1893. A receiving stylus for autographic or copying telegraphs made of conducting materials surrounded by a coating of wax or paraffin.

498,915. Electrode for Electric Arc Lamps; Salomon Heinmann, New York. Application filed Oct. 24, 1892. An electric arc lamp carbon provided with a refractory coating composed of a mixture of calcined soapstone, water glass, oil and lampblack.

498,919. Telephone; Barton Pickering, Dayton, O. Application filed Oct. 4, 1880. A permanent magnet with screw threads through both poles respectively for the adjusting screw and electromagnet in combination with a case and a diaphragm and helix.

498,949. Electric Glowlamp; E. A. Colby, Newark, N. J. Application filed Feb. 15, 1893. The combination in an electric glowlamp of an annular receiver, a support therein and a filament in the form of a closed spiral carried by the support and disposed concentrically with and inclosed in the receiver.

498 932. Trolley Stand; J. R. Griffiths, Chicago, Ill. Application filed July 2, 1892. This base has a coiled spring confined between end abutments, a rack bar with arms which have a bearing on the ends of the spring, and a segmental gear engaging the rack and having the trolley pole connected thereto.

498,933. Electric Railway Trolley; J. R. Griffiths, Chicago, Ill. Application filed July 6, 1892. The trolley pole consisting of sections, means for extending one of these sections relatively to the other, and a gravity catch operating on the extensible section to hold the same down when the extensible section is pressed down to catch, and the pole is swung out of perpendicular.

498,969. Dynamo-Electric Machine; W. S. F. Dillon, Chicago, Ill. Application filed Nov. 21, 1892. In a dynamo electric machine, field magnets and pole pieces constructed in two divisions or longitudinally split down their centres, both divisions of the magnets and poles being made hollow or chambered to accommodate fillings or cores of magnetic permeability, the magnets having the usual wire coils wound thereon.

498,987. Non-Interference Signal Box; C. E. Ongley, New York. Application filed Jan. 19, 1891. The combination with several transmitters of non-interference devices consisting of plates adapted to obstruct the keyholes, magnets adapted to move the plates in multiple arc branches of a normally open circuit, and means for closing the circuit by the use of any one of the transmitters.

498,988. Electric Signal and Protective System; Chas. E. Ongley, New York. Application filed Jan. 21, 1891. The combination of a time mechanism, a whistle or other alarm, a circuit extending from said alarm to said time mechanism for operating the alarm at predetermined hours, and a checkbox the opening of which is controlled in unison with alarm by the time mechanism.

499,003. Electrical Call Box; W. F. Banks, Milford, Conn. Application filed Nov. 25, 1892. A brush and shaft carrying a brake wheel having peripheral notches and having a crank and an arm engaging the block stop, adapted to be engaged by the arm for purpose set forth, and a spring-actuated train of gearing between the two shafts.

499,040. Metal Working; E. E. Ries, Baltimore, Md. Application filed Dec. 3, 1890. In a system of laying conductors in underground conduits, the condemnation of a permanent line of conductors established in the conduit and charged with suitable currents; with a portable welding apparatus, and means for tapping the permanent line by the welding apparatus at the manhole of the conduit.

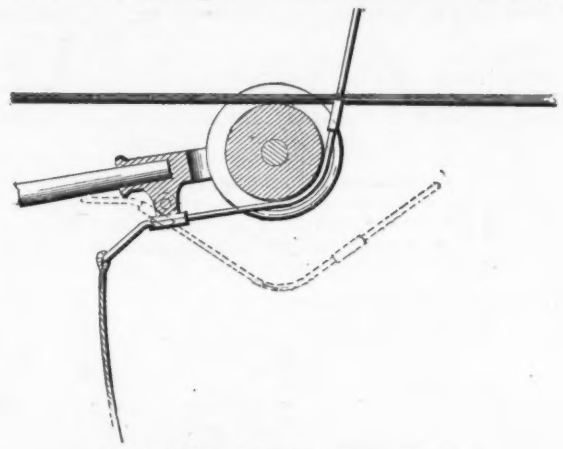
499,062. Electric Time Signal; Gerhard Wilhelm Van Vlanen, Cologne, Germany. Application filed Aug. 2, 1892. In an electric signal and alarm, the combination with a ring, screws and the dial plate, of the conducting disc or plate under the dial and provided with an arm having a contact spring to engage the screw points, and the springs engaging the periphery of the disc with their inner ends and screws for adjusting the springs.

499,090. Wire Coupling; John Bodine, Pittsfield, Ill. Application filed Nov 29, 1892. A wire coupling comprising a longitudinally bored body, two pivoted clamping dogs pivoted between their ends to the body and projecting at their inner ends into the bore, and a spring pressed plate bearing on the inner ends of both dogs.

499,095. Trolley Wire Finder; James Chase, Rochester, N. Y. Application filed Jan. 23, 1893. The combination with a trolley arm and trolley wheel of a shipper fulcrumed to the under side of the trolley arm and adapted to be swung upward between the trolley wheel flanges, a block secured to the upper end of the shipper and adapted to knock or scrape ice from the trolley wire, and a single guide arm or feeler secured in the block in position to be carried upward on one side of the trolley wire when the shipper is operated. (See illustration.)

499,097. Electric Illuminating Apparatus; E. A. Colby, Newark, N. J. Application filed Feb. 15, 1893. In an electric glow lamp, a receiver in the form of an annular tube, and a ring or closed coil filament without leading-in wires, disposed and supported in the axial line of the tube. (See illustration.)

499,099. Electro-Dynamic Machine; Olof Dahl, Paterson, N. J. Application filed Oct. 21, 1890. In an electro-dynamic machine, the combination of a shaft, an armature affixed thereto; two field magnets concentric with the shaft and symmetrically



No. 499,095.—TROLLEY WIRE FINDER.

situated with reference to the armature, magnetizing coils or windings on the field magnets also concentric with the shaft, pole pieces of one polarity extending from one end of the magnetizing coil of each magnet, and pole pieces of opposite polarity extending from the one end of the magnetizing coil of each magnet, the pole pieces being alternately of opposite polarity and being so arranged that those of one polarity in the one magnet shall extend toward and meet those of corresponding polarity of the other magnet, and shall be presented in this order to the armature.

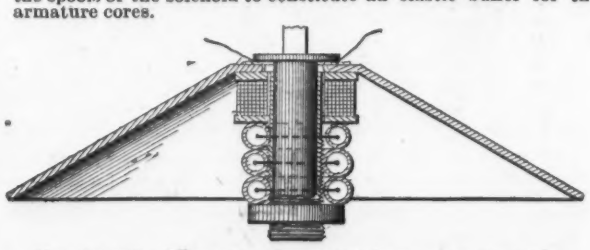
499,108. Telephone; E. M. Harrison, Fort Smith, Ark. Application filed May 31, 1892. In a phonetic transmitter the diaphragm having a transverse bridge and a carbon electrode, provided with a sharp contact edge, and secured to the bridge for making a perfect contact with the pendent anvil electrodes. (See illustration.)

499,112. Overhead Electric Railway; J. C. Henry, New York. Application filed Sept. 3, 1890. In combination with an overhead working conductor, metal posts supporting same and electrically connecting it to ground.

499,115. Electric Railway Trolley; G. W. Hooper, Rochester, N. Y. Application filed Aug 10, 1892. A trolley comprising a yoke, bushings supported by the yoke, a trolley wheel having an axle revolving within the bushings, and springs within the bushings at opposite ends of the axles.

499,125. Electric Signal Apparatus and System; J. W. Lattig, Easton, Pa. Application filed April 12, 1893. The combination with the signal, the motor and intermediate mechanism connecting the signal with the motor, of a brake or the mechanism, a motor circuit including the motor and controlled by or from the signal operating mechanism, and a brake controlling magnet included in a shunt from the motor circuit around the contacts.

499,126. Electric Signaling Apparatus and System for Railways; J. W. Lattig, Easton, Pa. Application filed Feb. 21, 1893. The combination of the signal, the solenoid having its armature cores connected to and adapted to operate the signal, and provided with a spring yielding yoke with cores entering the spools of the solenoid to constitute an elastic buffer for the armature cores.



No. 499,097.—ELECTRIC ILLUMINATING APPARATUS.

499,143. Trolley-Wire Support; Carl Peterson, Brooklyn, N. Y. Application filed Dec. 16, 1892. A trolley wire made in separate lengths, in combination with two bell-crank levers attached to adjacent lengths, each with an arm extended upward, detachably united, arranged substantially so that when a wire breaks the falling of the broken ends by gravity will effect such detachment and thus cut both the broken ends out of circuit, one of the upright arms thus engaged being embraced between two cheeks carried on the other.

499,167. Trolley-Wire Curve; R. M. Hunter, Philadelphia, Pa. Application filed Feb. 2, 1893. In an electric railway, the combination of a railway track having a curved portion, a suspended conductor arranged along the railway and about the curve thereof, angular tension devices connected to the suspended conductor and projecting laterally therefrom to hold it into position, and a second or working conductor arranged at the curved portion of the suspended conductor and secured and supported at a short distance below the suspended conductor by means of downwardly projecting portions of the angular tension devices.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.

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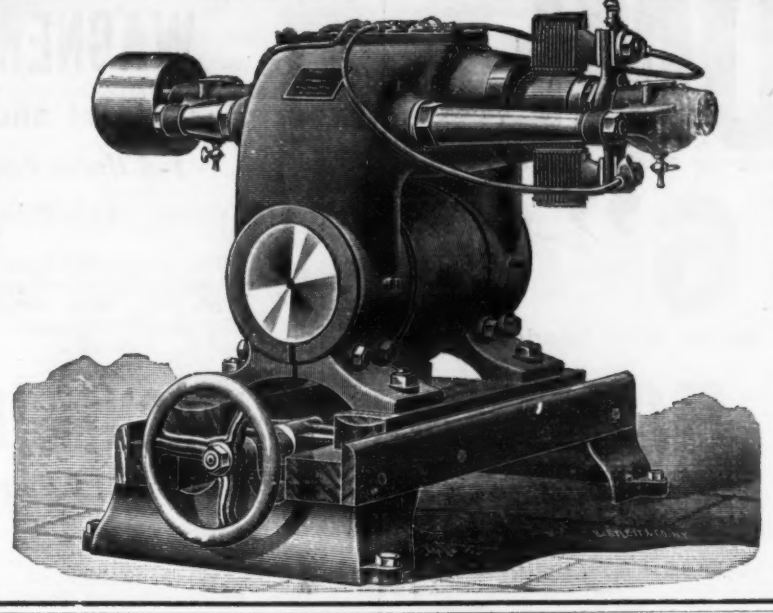

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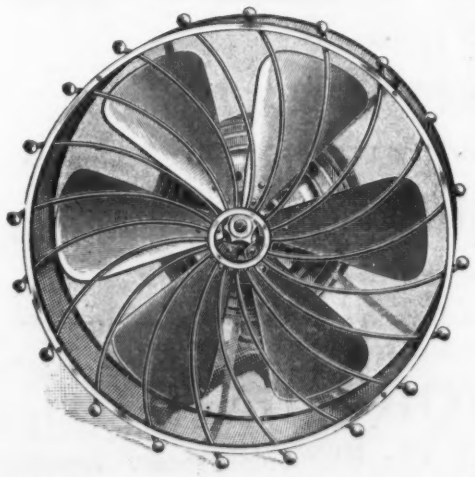

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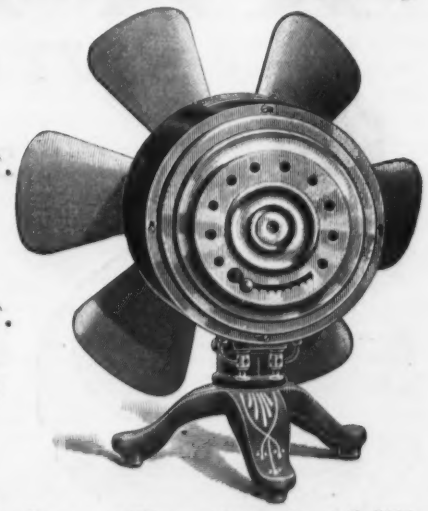

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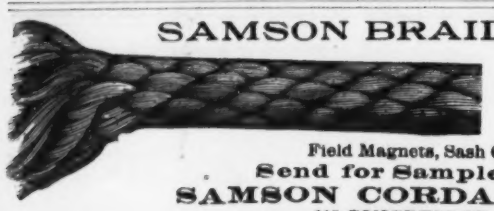

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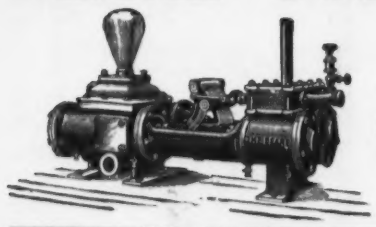

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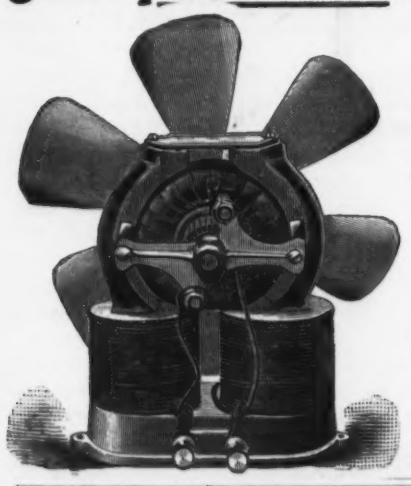

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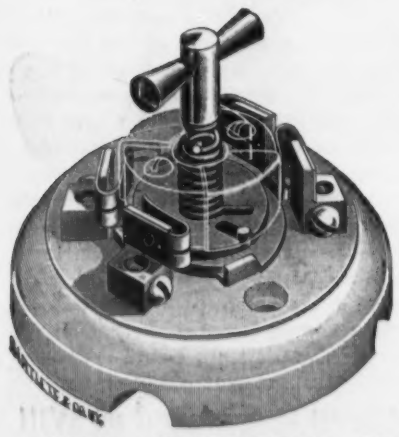

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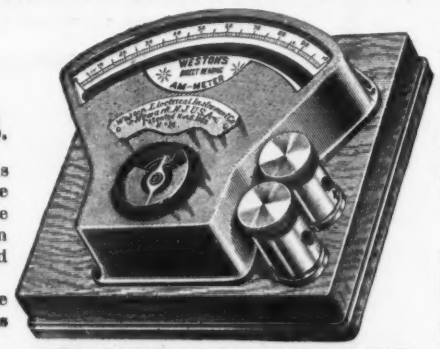

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